Hazardous Waste Manifest Cost Benefit Analysis

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BACKGROUND

The Environmental Protection Agency (EPA) is considering the role that electronic reporting will play in the overall collection of environmental data. Electronic reporting (ER) provides numerous benefits: 1) submitting and signing data electronically can reduce transaction costs for the agency and its trading partner; 2) transactions are quicker, 3) the data may be easier to access; and 4) organizational efficiencies often arise if the work process is organized around electronic submissions.

The EPA is taking an active role in evaluating and testing various electronic submission and signature options to ensure that the agency is capable of receiving electronic transmissions. As part of its efforts to re-invent environmental information, the EPA is beginning to use electronic commerce technologies to transmit environmental data.

The Hazardous Waste Manifest is a key document in recording the origin, movement, and disposal of hazardous waste. Over 2.99 million hazardous waste manifests are processed each year by the 24 states that participate in the program. Data contained in the manifest are critical elements of the Hazardous Waste Report (HWR). The manifest is one of the first documents to be analyzed with regard to electronic reporting.

The EPA's Office of Solid Waste (OSW) is writing a draft rule, to be released later in 2000, that will allow waste handlers to prepare, transmit, sign, and store manifests electronically. This rule will help change the way waste handlers conduct business and will legally provide for electronic signing and transmission of hazardous waste data between waste handlers and the states. Current EPA requirements specify that all manifest copies must be physically carried with the waste shipment; these requirements will be revised by this rule to allow the electronic transmission of the data. The draft rule also will propose standardized electronic data interchange (EDI) formats as well as Internet Forms. Standardizing electronic formats should reduce the need for data entry at all levels and reduce the number of paper copies kept by all waste handlers.

PURPOSE

The purpose of this report is to provide a technical options analysis for the manifest process in support of the EPA's effort to re-invent environmental information.

The assessment should be used to develop baselines and verifiable performance measures that track the agency's mission, strategic plans, and tactical goals. This report does not provide great detail on the current manifest process; we assume that the reader has a firm grasp on the paper process.

ORGANIZATION

- Chapter 1 contains general information on electronic reporting and the purpose of this report.
- Chapter 2 contains general information about the "as-is" paper submission process and the "to-be" electronic submission process, as well as the methodology involved in comparing these processes.
- Chapter 3 contains information about the "as-is" paper submission process.
- Chapter 4 contains information about initial investment costs for an information technology infrastructure.
- Chapter 5 contains information about the "to-be" electronic submission process.
- Chapter 6 contains analysis and conclusions.

Chapter 2
Overview of "As-Is" and "To-Be" Processes

The paper submission process for the manifest is based on regulations in the Code of Federal Regulations (CFR). These regulations affect the EPA and the Department of Transportation (DOT). The manifest helps to ensure that hazardous waste is disposed of appropriately. Current regulations that apply to the hazardous waste process were promulgated before recent changes in the information technology arena. Although the current paper process still applies, the EPA now has an opportunity to capitalize on the capabilities of the new computer-based technologies. The EPA is moving toward electronic reporting for the manifest; DOT regulations still require a shipping paper to be included throughout the process.

Information about the current paper process of the manifest is contained in 40 CFR 260–266. Specifically, 40 CFR 262 pertains to generators of hazardous waste; Part 263 pertains to transporters of hazardous waste; and Part 264 pertains to owners and operators of hazardous waste treatment, storage, and disposal facilities (TSDFs). DOT regulations are defined in Title 49 of the CFR.

The CFR defines a generator as a site whose process creates a hazardous waste or whose action first causes a hazardous waste to become subject to regulation. A transporter is a person who performs the offsite movement of a hazardous waste by any means (including air, rail, highway, or water). A designated facility is a TSDF that has received a permit or is regulated to treat, store, or dispose of a hazardous waste.[1] We used the "Regulatory Assessment of Proposed Modifications to the Resource Conservation and Recovery Act (RCRA) Manifest System and the Utility Consolidation Exemption—Draft Report" dated February 16, 2000, as the baseline for "as-is" manifest costs. Within that report, TSDFs are divided into commercial TSDFs and captive TSDFs. Most manifest processing is performed by commercial TSDFs; throughout the Regulatory Assessment, the commercial TSDF is referred to simply as the TSDF. For consistency, we also use simply TSDF throughout our analysis in this report.

The manifest is different from other EPA compliance reports in that it not only provides information of concern to the EPA but it also serves as a business document for waste handlers. These waste handlers use the manifest as proof that a waste was picked up, transported, and disposed of appropriately. On the basis of the manifest, waste handlers pay transporters as well as designated TSDFs for their services. In addition, the manifest is used to meet DOT requirements in an emergency.

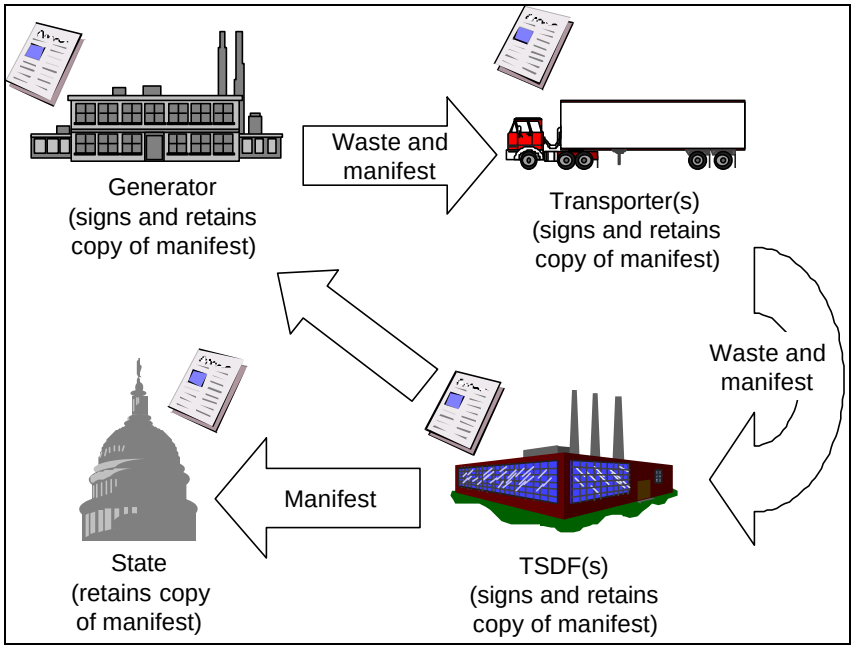
[1] 40 CFR 260.10, July 1, 1999.

"AS-IS" PROCESS OVERVIEW

The current process for the manifest is entirely paper based. The generator or the TSDF will create a manifest that contains detailed information about the hazardous waste. This paper manifest accompanies the cargo throughout the movement of the cargo from point of origin to point of destination. Each waste handler must sign the manifest before the next waste handler takes responsibility for the hazardous waste. Each waste handler also retains a copy of the manifest with his or her signature as well as all previous signatures on the manifest. Once the hazardous waste reaches its final destination at the designated TSDF, the TSDF retains a copy of the manifest with all previous signatures as well as its own and sends a copy with all signatures back to the generator. In some states, the designated TSDF also may be responsible for forwarding a copy of the manifest to the appropriate state authority.

Figure 2-1 reflects the flow of the current paper process for the manifest.

Figure 2-1. "As-Is" Hazardous Waste Paper Process



"TO-BE" PROCESS OVERVIEW

This section provides a discussion of potential technologies for use in "to-be" processes, as well as a high-level analysis of "to-be" models.

Infrastructure

EDI is the computer application-to-computer application exchange of machine-readable data in a standardized format such as American National Standards Institute (ANSI) Accredited Standards Committee (ASC) X12. Because this data exchange does not require human intervention, it eliminates redundant data entry and paper handling and thereby saves time and money. Added benefits include increased timeliness and accuracy of data. EDI also provides an acknowledgment of data receipt, an audit trail, and archiving features.

Extensible Markup Language (XML) is a technical specification that is used to develop business standards. XML was developed for data exchange in human-to-single-machine interfaces but is now regarded as a means of exchanging data over the Web in multiple-user-to-multiple-machine or machine-to-machine environments. To achieve this diversity, additional specifications based on XML have been created, including a Document Object Model (DOM), Namespaces in XML, XML Pointer Language, Extensible Style Sheet Language (XSL), XML Schema, XML Information Set, Resource Definition Framework, and XML Linking Language.[2] For the manifest, an XML structure could be used for machine-to-machine transactions as well as Internet Forms (human-to-single-machine interface).

In addition to analyzing different methods of transmitting data, the EPA is analyzing three types of electronic signature options. The first option is a software-based public key infrastructure (PKI) digital signature, which uses digital certificates to bind the identity of the submitter to a transaction. A PKI implementation provides the ability to authenticate the identity of users and verify that the data has not changed since the transaction was signed. A software-based digital signature uses a certification authority (CA)—a trusted third party—to issue a digital certificate to individuals. These certificates contain the public key of the signer; the signer's private key is used to digitally sign transactions. The user of a software-based solution keeps his or her private key secret but provides his or her public key to individuals he or she conducts business with. The sender of the electronic data signs the document using his or her private key and sends the document electronically to the receiver. The receiver then uses the public key provided by the sender to verify the identity of the sender and use the electronic data for its intended purpose. Prominent CA solution providers include Verisign, Entrust, and Netscape.

The second type of electronic signature option is a hardware-based PKI solution. This solution also binds the identity of the submitter to a transaction and provides the ability to authenticate the identity of users. However, a hardware-based solution, such as SecurEC, uses token card technology to create a digital signature; the

[2] *Open Buying on the Internet and Extensible Markup Language: Recommendations on Adoption by the Federal Government* (McLean, Va.: LMI, 2000).

cryptographic routines are embedded in the hardware token. The token card also contains the user's private key and digital certificate.

The third type of electronic signature option is a secured digitized signature using signature software and a digitizer pad. Digitized signature solutions such as PenOp entail capture of the image of a signature using a stylus and digitizing pad. The signature image is cryptographically bound to the document in a signature object so that if the document is changed, the signature will be invalidated. The signature object contains details on why the user signed, a cryptographic link to the data signed, biometric data based on how the user signed his or her name, and the date and time that the data was signed.

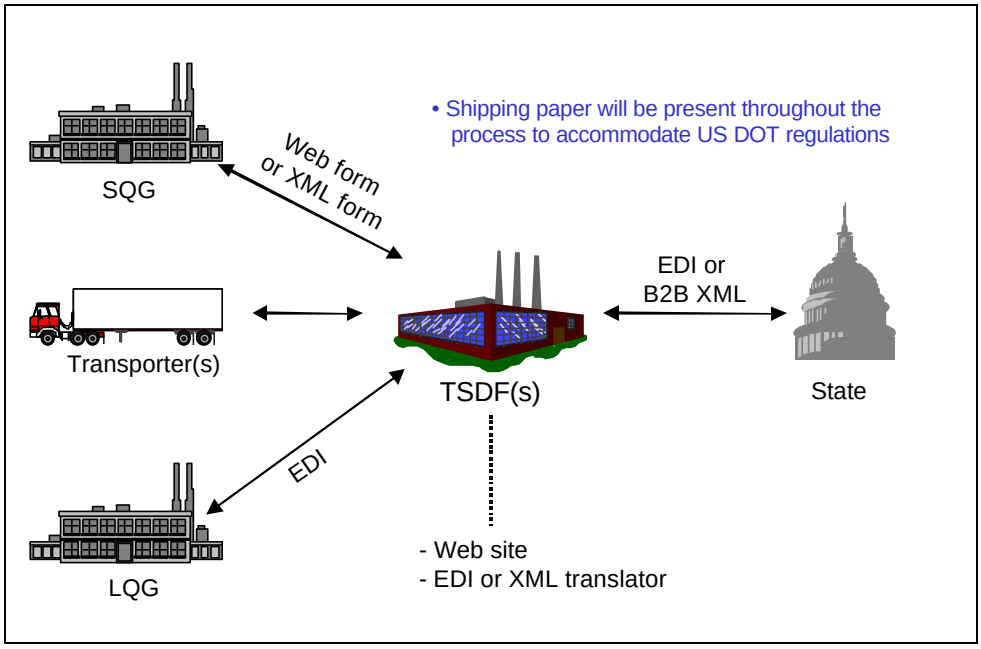
Models

We analyzed two potential models for the "to-be" process, each containing four submodels. The TSDF would play a large role in the "to-be" electronic process. Under each model, the TSDF would be responsible for creating and maintaining a robust Web site through which waste handlers would be able to access their hazardous waste data. In addition, these electronic manifests would be used as the copy of record for each waste handler at any time throughout the process. By creating and maintaining this Web site, the TSDF also would reduce the burden on generators and transporters.

In Model 1, the TSDF would forward the appropriate data directly to the states. The states would then be responsible for having an infrastructure in place to handle electronic data submission. The state would be responsible for providing an architecture to support electronic reporting, including an EDI or XML translator. The states also would need the ability to upload files in a predefined format into their database.

The submodels differ with regard to the type of signature utilized. Specifically, Model 1A entails a software-based PKI, Model 1B entails a hardware-based PKI, Model 1C entails a digitized signature, and Model 1D entails a handwritten signature obtained on a shipping paper. Figure 2-2 reflects the flow of Model 1 for the electronic manifest process.

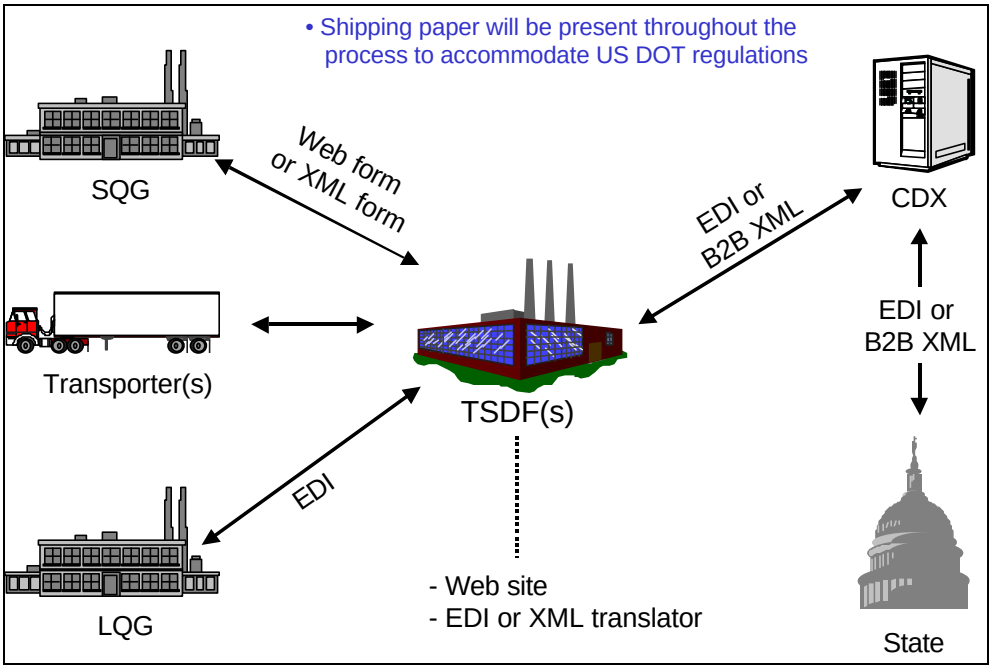
Figure 2-2. "To-Be" Hazardous Waste Manifest Electronic Process Model 1



In Model 2, the TSDF would forward the appropriate data to the state via the EPA's Central Data Exchange (CDX). Use of the CDX would eliminate the state's responsibility to build an infrastructure capable of receiving EDI or XML and place the burden on the EPA. The states' responsibility would be limited to having the ability to upload a file in a predefined format into the state database. The CDX would have a state-specific file format so that states would be able to properly upload the manifest data.

Again, each submodel differs with regard to the type of signature utilized. Model 2A assumes a software-based PKI, Model 2B assumes a hardware-based PKI, Model 2C assumes a digitized signature, and Model 2D assumes a handwritten signature on a shipping paper. Figure 2-3 reflects the flow of Model 2 for the electronic manifest process.

Figure 2-3. "To-Be" Hazardous Waste Manifest Electronic Process Model 2



The EPA is assessing two electronic methods for receiving electronic data from hazardous waste handlers. Because small-quantity generators (SQGs) may not have the infrastructure to support a large electronic infrastructure, we anticipate that these waste handlers would use a Web form or an XML-based form. We expect that many of the large-quantity generators (LQGs) may already have an infrastructure in place to accommodate business-to-business (B2B) movement of data; as a result, we expect that these waste handlers would use EDI or XML to submit their data to the TSDF. Transmissions of data from the TSDF to the state, where appropriate, would be in an EDI or a B2B XML format. Where the TSDF submits data to the CDX, the structure of the data could be EDI or B2B XML.

METHODOLOGY

Baseline Analysis

This report analyzes various electronic formats and electronic signature options. We used the "Regulatory Assessment of Proposed Modifications to the Resource Conservation and Recovery Act (RCRA) Manifest System and the Utility Consolidation Exemption—Draft Report," dated February 16, 2000, as the baseline for the current, "as-is" manifest process. This report segments the manifest process into seven areas: preparing the manifest, transmitting the manifest, maintaining manifest records, acquiring new manifest forms, submitting copies to states, submitting manifest-related reports, and employee training. Because we focus here only on the manifest, we do not include submission of manifest-related reports in our analysis.

We also address data entry in the context of areas defined in the Regulatory Assessment, information systems, and security options as they apply to the current paper process. Because these areas are not discussed in the Regulatory Assessment we used for the baseline, we made assumptions and estimates about the infrastructure that waste handlers currently are using. We do know that in the current process, many of the larger waste handlers have systems into which they are keying manifest data. These systems are mutually independent, so data entry personnel are keying the same data into different systems multiple times. Simply enabling these systems to share data would reduce data entry costs significantly. Within each area, we discuss the assumptions we made and any estimates we calculated. In addition, Appendix B of the Regulatory Assessment report contains detailed cost data for each of the areas segmented within the report, including the number of manifests, burden, labor rates, and, where applicable, postage.

"To-Be" Process Analysis

For the analysis of "to-be" models, we obtained data from Sterling Commerce, DPRA, Sparta, Netscape, Verisign, and Entrust.

We segmented the discussion of proposed electronic models into the same areas as we used for the discussion of the "as-is" process. Again, we have excluded submission of manifest-related reports because we are focusing on the manifest; in this document we have included information systems and security options. We estimated how these costs would vary based on the introduction of an electronic process. Where the costs are incurred has shifted from these core areas in the baseline report into information systems and security to support an electronic manifest.

Chapter 3
"As-Is" Paper Submission Process

This chapter provides a detailed discussion of the "as-is" process and the costs associated with this process.

PREPARING THE MANIFEST

A manifest must be prepared by a generator who transports or arranges to transport hazardous waste for off-site treatment, storage, or disposal. These manifests can be prepared by the generator, by a TSDF, or by a broker. According to 40 CFR 262.23, the generator must sign the manifest certification by hand. In addition, the generator must provide enough copies of the manifest for the generator, each transporter, and the owner or operator of the designated facility to retain one copy each for their records. The manifest usually includes four, six, or eight copies. Once the TSDF receives the waste, it must return a signed copy to the generator. An additional copy of the manifest may be required by the state(s) in which the waste was handled.

Cost Analysis

Table 3-1 shows total annual costs for manifest preparation.

Table 3-1. Total Annual Costs for Manifest Preparation

Stakeholder type	Total annual cost
SQG	$5,216,181
LQG	$17,518,551
Small TSDF	$1,988,739
Medium TSDF	$9,943,694
Large TSDF	$27,842,344
Transporter(s)	$2,264,824
State(s)	$0
EPA	$0

TRANSMITTING THE MANIFEST

Before the transporter leaves the generator's facility, the transporter must sign and date the manifest to acknowledge acceptance of the hazardous waste. The transporter must return a signed copy to the generator before leaving the generator's property. In addition, the transporter must ensure that a copy of the manifest accompanies the shipment. When the waste is delivered to another transporter or to the TSDF, the transporter must obtain the date of delivery and the signature of the transporter or TSDF to which the waste is being delivered. The initial transporter also must retain one copy of this signed manifest and give the remaining copies to the accepting transporter or TSDF. The process of signing the manifest, keeping a copy, and giving additional copies to the next recipient continues until the hazardous waste is received by the designated TSDF. The designated TSDF reviews the manifest, signs it, gives a copy to the transporter, and sends a copy to the generator by regular mail.

Cost Analysis

Table 3-2 shows total annual costs for manifest transmission.

Table 3-2. Annual Costs for Manifest Transmission

Stakeholder type	Total annual cost
SQG	$945,851
LQG	$1,227,757
Small TSDF	$1,672,308
Medium TSDF	$8,361,541
Large TSDF	$23,412,314
Transporter(s)	$23,686,044
State(s)	$0
EPA	$0

MANIFEST RECORDKEEPING

The CFR recordkeeping requirement specifies that each hazardous waste handler must retain all signed manifests they send or receive for a minimum of three years. Specifically, the generator must keep a copy of each signed manifest for at least three years from the date the initial transporter accepted the waste. Transporters must keep a copy of the manifest signed by the transporter, the generator, and the next transporter or designated TSDF for three years from the date the initial transporter accepted the shipment. Finally, the designated TSDF must keep a signed copy of the manifest for three years from the date it received the shipment.

Cost Analysis

Table 3-3 shows total annual costs for manifest recordkeeping.

Table 3-3. Annual Cost for Manifest Recordkeeping

Stakeholder type	Total annual cost
SQG	$5,094,782
LQG	$6,613,255
Small TSDF	$1,197,125
Medium TSDF	$5,985,627
Large TSDF	$16,759,755
Transporter(s)	$12,728,944
State(s)	$22,399,133
EPA	$0

ACQUIRING NEW MANIFEST FORMS

Even though the EPA provides a uniform manifest, some states may require the use of a state-specific manifest. If the state requires a specific manifest, the generator must use the state-specific manifest. In addition, some states charge a fee for the manifest they require waste handlers to use. If a state does not specify which manifest to use, the generator should use the uniform manifest provided by the EPA.

Cost Analysis

Table 3-4 shows total annual costs for acquisition of new manifest forms.

Table 3-4. Annual Cost for Acquisition of New Manifest Forms

Stakeholder type	Total annual cost
SQG	$237,459
LQG	$939,178
Small TSDF	$235,720
Medium TSDF	$1,178,601
Large TSDF	$3,300,081
Transporter(s)	$286,918
State(s)	$0
EPA	$0

SUBMITTING COPIES TO STATES

Some states require generators and designated TSDFs to submit copies of their manifests to the state. In such cases, the generator and the designated TSDF simply mail copies of their manifests to the state. In many instances, waste handlers will send their manifests in bulk on a monthly basis to the appropriate state.

Cost Analysis

Table 3-5 shows total annual costs for submission of manifest copies to states.

Table 3-5. Annual Costs for Submission of Manifest Copies to States

Stakeholder type	Total annual cost
SQG	$4,150,464
LQG	$6,771,810
Small TSDF	$1,690
Medium TSDF	$8,448
Large TSDF	$23,653
Transporter(s)	$0
State(s)	$0
EPA	$0

EMPLOYEE TRAINING

DOT regulations require each waste handler involved in manifest preparation to provide training to employees who prepare manifests. According to 49 CFR 172.704, training involves familiarizing the employee with the requirements defined in the CFR, as well as enabling the employee not only to recognize but to identify hazardous materials. The employee must complete initial training within 90 days of employment or change in job function that requires them to prepare manifests. In addition, employees are required to participate in recurrent training once every three years.

Cost Analysis

Table 3-6 shows total annual costs for employee training.

Table 3-6. Annual Costs of Employee Training

Stakeholder type	Total annual cost
SQG	$299,092
LQG	$2,402,534
Small TSDF	$80,098
Medium TSDF	$400,492
Large TSDF	$1,121,378
Transporter(s)	$5,600,138
State(s)	$0
EPA	$0

INFORMATION SYSTEMS

The regulatory analysis and the Information Collection Request (ICR) document only the manual processes for working with the paper manifest. Many of the stakeholders also manage the disposal process with automated systems, however. We assume that the cost incurred to design and develop these systems is a sunk cost; we do not consider it in this analysis. The annual operating expense for these systems is a significant part of the "as-is" cost, however, and must be included in any comparison with a "to-be" system. We include the costs for data entry or printing in other categories (e.g., manifest preparation). This section addresses costs related only to managing the systems themselves.

Cost Analysis

Table 3-7 shows total annual costs for information systems.

Table 3-7. Annual Costs of Information Systems

Stakeholder type	Total annual cost
SQG	$67,065,000
LQG	$137,175,000
Small TSDF	$454,688
Medium TSDF	$150,000
Large TSDF	$75,000
Transporter(s)	$0
State(s)	$990,000
EPA	$0

SECURITY

In the "as-is" environment there is little, if any, electronic data exchange between among the participants in the process. Typically, if a LQG has an information system that prepares manifests, the generator will print out the manifest from this system. Once the manifest has been printed, the generator will mail or fax the manifest to the TSDF. The receiving party (TSDF, state, transporter, etc.) will then rekey the manifest into its own system. Everyone relies on the written and manually signed document for authentication. For this reason, all "as-is" security costs are zero.

SUMMARY

Total National Costs

Table 3-8 shows total annual national costs for the manifest process. Detailed cost developments for these processes are provided in Appendix A.

Table 3-8. Total Annual National Costs for the Manifest Process ($000)

Stakeholder	Preparing the manifest	Transmitting the manifest	Manifest recordkeeping	Acquiring new manifest forms	Submitting copies to states	Employee training	Information systems	Security	Total Cost
SQG	$5,216	$946	$5,095	$237	$4,150	$299	$67,065	$0	$83,009
LQG	$17,519	$1,228	$6,613	$939	$6,772	$2,403	$137,175	$0	$172,648
Small TSDF	$1,989	$1,672	$1,197	$236	$2	$80	$455	$0	$5,630
Medium TSDF	$9,947	$8,362	$5,986	$1,179	$8	$400	$150	$0	$26,028
Large TSDF	$27,842	$23,412	$16,760	$3,300	$24	$1,121	$75	$0	$72,535
Transporter(s)	$2,265	$23,686	$12,729	$279	$0	$5,600	$0	$0	$44,559
State(s)	$0	$0	$22,399	$0	$0	$0	$990	$0	$23,389
EPA	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total cost	$64,793	$59,309	$70,779	$6,170	$10,956	$9,904	$205,910	$0	$427,817

Total Unit Cost

Table 3-9 shows total unit costs for the manifest process. Detailed unit cost developments for these processes are provided in Appendix A.

Table 3-9. Total Unit Cost Per Manifest

Stakeholder	Preparing the manifest	Transmitting the manifest	Manifest recordkeeping	Acquiring new manifest forms	Submitting copies to states	Employee training	Information systems	Security	Total cost
SQG	$4.81	$0.99	$2.74	$2.55	$5.83	$0.32	$72.12	$0	$89.31
LQG	$9.70	$0.99	$2.74	$2.68	$5.83	$1.99	$113.64	$0	$136.91
Small TSDF	$12.01	$12.31	$7.95	$2.51	$7.42	$5.41	$30.72	$0	$73.45
Medium TSDF	$13.32	$12.31	$7.95	$2.51	$7.42	$5.41	$2.03	$0	$46.07
Large TSDF	$13.32	$12.31	$7.95	$2.51	$7.42	$5.41	$0.36	$0	$44.41
Transporter(s)	$28.88	$9.44	$5.10	$2.52	$0	$71.41	$0	$0	$117.35
State(s)	$0	$0	$9.21	$0	$0	$0	$0.41	$0	$9.61
EPA	$0	$0	$0	$0	$0	$0	$0	$0	$0.00
Total	$82.05	$48.35	$43.62	$15.28	$33.92	$89.96	$219.27	$0	$517.11

Chapter 4
"To-Be" Information Technology Development

The intent of the proposed manifest rule and the "to-be" manifest system is to move from a paper-based process to an electronic process.[1] Chapter 2 provides an overview of the "to-be" system. This chapter and Chapter 5 provide greater detail regarding the "to-be" system and estimated costs. Specifically, this chapter describes the *one time* costs to design and develop the "to-be" system.

RATIONALE FOR "TO-BE" TECHNICAL APPROACH

Most environmental reporting consists of a facility monitoring events, then completing a form and submitting the form directly to the EPA or a delegated state environmental agency. Typically, this reporting is the sole purpose of the form (e.g., Toxic Release Inventory Form R). The manifest is unique in several ways:

- It is a key component in the *business process* among generators, transporters, and disposal firms to request, manage, and pay for disposal services.
- It is also used to meet DOT requirements for emergency response.
- Tracking the waste itself is separate from the manifest. During the disposal process, waste may be placed at an interim TSDF and then reshipped under a different manifest. At such locations, the waste may be consolidated or split. The waste also may be pretreated and thus undergo a change in treatment codes prior to final disposal.
- A single manifest is routed amongst several trading partners. Typically there will be at least a generator, a transporter, and a TSDF. Often there may be multiple transporters or TSDFs. Each participant is required to sign for receipt of the waste.
  - ➢ Manifests are not signed by corporate officers but by production staff such as truck drivers and loading dock supervisors; there are many signing parties across all the participants.
  - ➢ Signatures occur in a of variety locations, often in "field" conditions.

As noted in the last bullet there is a large variety of stakeholders: organization types, organizations, and individuals that process both individual manifest and

[1] A paper manifest will continue to accompany the physical movement of the waste, to support law enforcement and emergency response requirements.

manifests collectively. The next session discusses the participants in greater detail.

System Participants

One of the key aspects of the manifest is the large number of organizations and individuals within those organizations that are involved in the process.

- *TSDFs.* The TSDFs are central to the entire process and to all of the foregoing issues. These companies range from large organizations with organic transportation and numerous TSDFs to small, specialized organizations that may operate a single TSDF. Approximately 500 such firms operate in the United States. A typical larger firm will provide "cradle to grave" services for its generators/customers: documenting the waste profile, completing the manifest form, picking up the waste, coordinating treatment and disposal, providing manifests to state environmental agencies, and providing any additional required documentation. For these reasons, the proposed "to-be" model features TSDFs as the primary developers of the electronic system.

  These companies will build systems to serve their customers and gather together manifest information. They also will supply final disposal information to the states. For the purposes of our model, we have grouped these companies into three categories:

  - Large TSDFs with many customers, high transaction volumes, and working with numerous TSDFs. There are very few companies in this group. To implement, these companies will have to operate large systems with significant telecommunications capabilities with the attendant costs.

  - Intermediate TSDFs with a moderate number of customers and working with at least a few TSDFs. The regulatory analysis does not breakdown TSDFs by size, but we assume there are also very few of these size companies.

  - Small TSDFs, with correspondingly small customer bases, transaction volumes, and TSDFs. Given that there are more than 500 firms identified in the regulatory analysis and a relatively few handle the great majority of the waste, there must be a large number of small TSDFs. We assume many of these will not implement at all, and those that do will implement simple PC systems.

    The size and cost of the "to-be" system development effort reflect these distinctions. Furthermore, many intermediate and small companies simply will not automate.

- *Generators.* The existing ICR has classified generators as SQGs or LQGs; we follow that distinction in our model. We assume the SQGs will not have an automated system and that they will use Web forms provided by the TSDF to complete and sign their manifests. We assume LQGs will have automated systems to track their waste. Our model includes costs for LQGs to convert their systems and exchange manifests with the TSDF via EDI or XML.

- *Transporters.* TSDFs often provide their own organic transportation capability, but in many cases the transporters are independent. Transporters are mainly concerned with carrying the printed manifest copies and signing the forms as they accept and release the waste. We assume a very low level of automation on the part of transporters. We also assume that they will digitally sign Web forms provided by the TSDFs.

- *States.* We assume all 24 states that collect manifests have some form of system to receive and process manifests sent from the TSDFs. Our model includes costs for the states to revise their systems to receive EDI or XML data from the TSDFs. The primary distinction between Models 1 and 2 relates to state processing. Model 1 assumes that the states will undertake the effort to accept input in a nationally defined format established by the EPA. Model 2 assumes that the EPA's CDX will receive data from TSDFs and reformat the data into a format that is convenient to each state. This model increases the burden on the CDX but reduces it for the states.

- *CDX.* The CDX is a facility that receives, authenticates, edits, archives, and transforms data from submitting organizations and provides the data to EPA national systems and other systems as required. In Model 1, the CDX has no role or assigned costs. In Model 2, the CDX would provide assistance to the states by receiving disposal manifests from the TSDFs in a standard format, authenticate the source, archive the data, and reformat it into formats that the states can process readily.

All of these characteristics of the manifest model, but in particular the stakeholder types, calls for a flexible approach to supporting electronic compliance reporting. This is particular an issue as to how the electronic is applied, and this is reflected in our proposed "to-be" model which focus on 4 options for applying processing signatures.

"TO-BE" MODEL DEVELOPMENT COSTS

We present two primary models in this report. For both models, we assume that the TSDFs[2] will incur the major burden of expanding their existing waste tracking systems into electronic commerce systems. The TSDFs will provide Web-form submissions (primarily for SQGs) and electronic file transfer (via either EDI or XML) for interested customers (assumed to be the LQGs). In addition to developing these systems, the TSDFs will be responsible for implementing a digital signature and electronic recordkeeping approach that meets the legal requirements of the proposed rule. Lastly, the TSDFs will generate outbound electronic files of disposed waste in accordance with EPA guidelines.

Models 1 and 2 are identical except for their assumptions regarding the transfer of data from the TSDFs to the states. In Model 1, the TSDFs will output files directly to the state. The states will revise their systems to receive the XML or EDI files. In Model 2, the CDX will receive completed manifests from the TSDFs in EDI or XML format and convert the data into a format that is most readily acceptable to each of the states. This effort will reduce the burden on the states but place an additional burden on the EPA.

Table 4-1 lists the costs associated with the design and development of computer systems to process electronic manifest systems. The detailed cost elements associated with the investment costs shown in Table 4-1 are derived in Appendix B. The investment costs by stakeholder type developed in Appendix B (less any security costs), multiplied by the number of organizations implementing an electronic infrastructure yields the investment costs shown in Table 4-1.

[2] Most hazardous waste disposal is conducted by commercial hazardous waste management firms that provide a wide variety of services to generators—performing waste profile analysis, developing manifests and supporting documents, coordinating transportation and performing disposal, and certifying disposal. Some of these companies are very large and operate many TSDFs as well as transportation assets; others are small firms that operate only a single TSDF. The large commercial waste management firms (not individual TSDFs) will build and operate the "to-be" systems. For the sake of simplicity and consistency with the regulatory analysis and the ICR, however, we refer to all of these companies as TSDFs.

Table 4-1. Investment Costs to Develop an Electronic Infrastructure ($000)

Stakeholders	Model cost ($)				Quantity	Percentage implementing
	1A, C, D	1B	2A, C, D	2B		
SQG	$0	$0	$0	$0	0	0
LQG	$68,588	$68,588	$68,588	$68,588	13,718	90
Small TSDF	$462	$462	$462	$462	5	1
Medium TSDF	$1,425	$1,569	$1,425	$1,569	10	50
Large TSDF	$679	$679	$679	$679	1	100
Transporter(s)	$0	$0	$0	$0	0	0
State(s)	$1,258	$1,258	$1,010	$1,010	24	100
EPA	$0	$0	$228	$228	1	100
Total model cost	$72,411	$72,555	$72,392	$72,536	13,759	N/A

Note: "Quantity" indicates the approximate number of organizations within the category; "percentage implementing" is the estimated percentage of those organizations that will develop "to-be" systems.

Security and Electronic Signature Submodels

Applying a legally binding electronic signature is by far the most challenging technical aspect of the proposed rule. This section describes three different approaches to applying an electronic signature. These submodels reflect the most common approaches used in industry today and are generally similar in approach; they vary significantly, however, in their costs to develop and operate. One widely discussed approach—biometrics—is not included because we felt it would be too complex and expensive to even consider.[3] The fourth submodel dispenses with electronic signatures and retains a paper signature.

- *Submodel A* incorporates a digital signature that uses a software-based PKI. In this submodel, a printed copy of the manifest accompanies the waste for DOT purposes but is not signed and can be destroyed upon receipt at the TSDF.

  Software based PKI is a very common approach that is being used by the CDX and other Federal Agencies, and is the basis for the GSA ACES PKI contracts. Of three electronic signature submodels, this one is the easiest to implement

- *Submodel B* incorporates a digital signature through a hardware token that contains the signee's digital identification. This token could be in the form of a smart card or a variety of other such devices. Once the manifest is signed, Submodels A and B are similar. In Submodel B, a printed copy of the manifest accompanies the waste for DOT purposes but is not signed

[3] *Biometrics* refers to techniques such as retinal scan, fingerprints, voice recognition, and so forth. Digitized signature vendors contend that a digitized signature is biometric in that signature pressure, speed, stroke order, and other characteristics are biometric. We neither dispute nor support this contention; for the purposes of this report, however, we did not classify it as biometric.

and can be destroyed upon receipt at the TSDF.

This submodel is basically the same as submodel A except that it provides a higher level of security by requiring the signer to both "know something and to have something." However, it is significantly more expensive to implement and operate. Our experience has shown that installing the token readers is often a major burden to the user community.

- *Submodel C* is significantly different in that it is based on signature software and a digitizer pad that record a digitized image of the individual's signature. In this submodel, a printed copy of the manifest accompanies the waste for DOT purposes but is not signed and can be destroyed upon receipt at the TSDF.

  Since this submodel generates an image of the actual signature, it may be easier to enforce in legal cases and it also eliminates the recordkeeping associated with managing the passwords, pins, and/or tokens required in the first two submodels. However, as in Submodel B this approach requires users to add hardware to their systems.

  Note that Submodels B and C may require generators and transporters dealing with more than one TSDF to support multiple tokens and/or readers on their systems.

- *Submodel D* does not use an electronic signature. Data are transmitted and processed electronically, but the paper copy that follows the waste continues to be signed. When it arrives at the TSDF, it is retained for records and likely scanned into some form of document image system.

  This clearly is the "low-tech" approach. However, it minimizes the costs associated with security, and retains the simplicity of paper for legal purposes. At the same time it reaps most of the advantages of improved accuracy, reduced processing times, increased flexibility, and reduced costs of electronic processing.

Note that for processing through receipt at the TSDF, Models 1A and 2A are the same, as are 1B and 2B, and so forth. The two primary models vary only at the back end for getting the data from the TSDF to the state either directly or via the CDX.

Although each of these four submodels will provide the TSDF with a signed document (electronic or paper), the cost to implement (and operate) each submodel varies significantly. Table 4-2 lists the cost associated with the design and development of a security solution for each of the four submodels. (Additional detail appear in Appendix B.)

Table 4-2. Costs to Develop a Security Solution

Stakeholders	Model cost ($)								Quantity	Percentage implementing
	1A	1B	1C	1D	2A	2B	2C	2D		
SQG	$0	$0	$0	$0	$0	$0	$0	$0	0	0
LQG	$0	$0	$0	$0	$0	$0	$0	$0	13,718	0
Small TSDF	$400	$4,640	$688	$0	$400	$4,640	$688	$0	5	1
Medium TSDF	$4,353	$88,400	$3,750	$0	$4,353	$88,400	$3,750	$0	10	50
Large TSDF	$435	$8,840	$375	0	$435	$8,840	$375	0	1	100
Transporter(s)	$0	$0	$0	$0	$0	$0	$0	$0	0	0
State(s)	$0	$0	$0	$0	$0	$0	$0	$0	24	100
EPA	$0	$0	$0	$0	$0	$0	$0	$0	1	100
Total Security Cost	$5,188	$101,880	$4,813	$0	$5,188	$101,880	$4,813	$0	13,759	N/A

The total costs for each investment and security option are shown in Table 4-3.

Table 4-3. Total Costs to Develop "To-Be" Process

	1A	1B	1C	1D	2A	2B	2C	2D
Infrastructure Investment	$72,411	$72,555	$72,411	$72,411	$72,392	$72,536	$72,392	$72,392
Security	$5,188	$101,880	$4,813	$0	$5,188	$101,880	$4,813	$0
Total	$77,599	$174,435	$77,223	$72,411	$77,580	$174,416	$77,204	$72,392

Chapter 5
"To-Be" Annual Operating Costs

BACKGROUND

This chapter presents the annual costs to operate the two "to-be" models, each with four signature submodels. (Additional detail regarding our analysis and assumptions appears in Appendix C.) For the "to-be" analysis, we use the same processing areas we used to describe the "as-is" process.

PREPARING THE MANIFEST

Many of the same requirements will still exist for electronic submission. A manifest will still be prepared by a generator or a designated TSDF who transports hazardous waste for off-site treatment, storage, or disposal. The manifest will be prepared on the Web site provided by the TSDF and then transmitted electronically by the generator to the first transporter. We have assumed some savings in the to-be system in that automated systems may perform better data validations, and data can often be re-used from previous work more efficiently than can be done in the "as-is," paper-based process.

Department of Transportation (DOT) regulations will continue to require a hard-copy shipping paper to be held with the shipment in case of an emergency.[1] Except in Submodel D, however, this form will not be signed; the electronic copy will be the official record. When an electronic signature is involved, the electronic manifest would be signed with a digital or digitized signature. Submodel D continues to use the shipping paper required by the DOT as the official signature copy. Each waste handler would sign the shipping paper, and the TSDF would retain the master copy. Although this submodel may be less "attractive" than those that use electronic signatures, it dramatically reduces the design and operating costs of the security portion of the "to-be" system while retaining the efficiencies of exchanging the data electronically.

[1] Clearly, at some future date hazardous waste cargoes will carry electronic transponders to identify waste contents, but this extensive effort is outside the scope of this analysis.

Annual Cost

Table 5-1 shows total annual costs for manifest preparation in the "to-be" environment.

Table 5-1. "To-Be" Annual Costs for Manifest Preparation

Stakeholder	Model 1	Model 2
SQG	3,600,839	3,600,839
LQG	6,089,287	6,089,287
Small TSDF	1,521,708	1,521,708
Medium TSDF	7,608,540	7,608,540
Large TSDF	21,303,912	21,303,912
Transporter(s)	2,162,907	2,162,907
State(s)	0	0
EPA	0	0

TRANSMITTING THE MANIFEST

Transmission of the manifest to the multiple waste handlers will be very different in the electronic environment than in the paper process. For EPA requirements, transmission of the manifest can be a completely automated process. The generator would electronically create the manifest on the TSDF Web site. The initial transporter will access the electronic manifest, verify the data, and send a copy of the manifest back to the generator, as well as to the next recipient of the waste. In the end, all entities that handle the hazardous waste will receive and verify the electronic manifest data. An electronic copy of the manifest will also be sent—either directly from the TSDF or through the CDX—to the state in which the waste was handled. In this processing area, all of the "to-be" submodels show significant savings over the "as-is" model because the cost to re-enter data into independent information systems is eliminated.

Again, for electronic signatures, each waste handler would sign the electronic manifest with digital or digitized signature technology. If a paper-based signature process is used (Submodel D), the shipping paper would be signed by each waste handler and forwarded, with the cargo, to the next waste recipient. The TSDF would maintain the master copy of the manifest with all the handwritten signatures.

Annual Cost

Table 5-2 shows total annual costs for manifest transmission in the "to-be" environment.

Table 5-2. "To-Be" Annual Costs for Manifest Transmission

Stakeholder	Model 1	Model 2
SQG	262,474	262,474
LQG	119,706	119,706
Small TSDF	1,153,843	1,153,843
Medium TSDF	5,769,217	5,769,217
Large TSDF	16,153,809	16,153,809
Transporter(s)	5,426,782	5,426,782
State(s)	0	0
EPA	0	0

MANIFEST RECORDKEEPING

Manifest recordkeeping in the "as-is" process consists of reproducing (as needed) and filing all manifests processed by stakeholders, including generators, transporters, and TSDFs. Obviously, the 24 participating states also perform this function. The current and proposed rules require records to be maintained for at least three years. In the "to-be" process, records would be maintained electronically and printed only as needed. This method of recordkeeping will eliminate human processing costs and overhead associated with managing physical files. These savings would be partially offset by hardware/software costs and human costs to maintain the electronic archives. Again, Submodel D is different in that we assume that the designated TSDF will also scan and electronically retain the signed manifest.

Annual Cost

Table 5-3 shows total annual costs for manifest recordkeeping in the "to-be" environment.

Table 5-3. "To-Be" Costs for Manifest Recordkeeping

Stakeholder	Model 1	Model 2
SQG	1,393,557	1,393,557
LQG	635,559	635,559
Small TSDF	68,869	68,869
Medium TSDF	344,344	344,344
Large TSDF	964,162	964,162
Transporter(s)	2,395,266	2,395,266
State(s)	1,383,030	0
EPA	0	30,131

ACQUIRING NEW MANIFEST FORMS

In the "to-be" process, the need to acquire new manifest forms from the state or the EPA would no longer exist. The generator would access a Web form provided by the TSDF to create the manifest. Costs for this processing area are retained to reflect the percentage of the community that continues to operate in the paper-based environment.

Annual Cost

Table 5-4 shows total annual costs for acquisition of new manifest forms in the "to-be" environment.

Table 5-4. "To-Be" Costs for Acquisition of New Manifest Forms

Stakeholder	Model 1A	Model 2D
SQG	35,619	35,619
LQG	46,959	46,959
Small TSDF	23,572	23,572
Medium TSDF	117,860	117,860
Large TSDF	330,008	330,008
Transporter(s)	27,892	27,892
State(s)	0	0
EPA	0	0

SUBMITTING COPIES TO STATES

In the "to-be" process, the designated TSDF will transmit completed manifests (i.e., manifests pertaining to disposed waste) to the appropriate state environmental office electronically rather than on paper. This method of submission will

eliminate the state's costs for keying data into its system. It also will reduce the state's cost for reviewing and retaining manifests.

Under Model 2, all TSDFs would use a common electronic format to transmit the data. This transmission will entail either an EDI transaction set—namely, the 861 Receipt transaction set or the same data coded into an XML schema. The EPA, in coordination with the other stakeholders, will make a determination about which approach to use. Although there are some cost differences between EDI and XML, the choice will not significantly effect our analysis; the design and operating costs reflect an average of both approaches.

It is only in this processing area is that Model 1 and Model 2 are different. For the states, Model 1 will entail higher annual operating costs to maintain the EDI or XML infrastructure as opposed to maintaining a file transfer format of the states' choosing. These costs are considered as part of the "to-be" Information Technology costs. Conversely, the EPA costs for Model 1 are zero, whereas there is a significant cost to the EPA in Model 2.

Annual Cost

Table 5-5 shows total annual costs for submission of manifest copies to states in the "to-be" environment.

Table 5-5. "To-Be" Annual Costs for Submission of Manifest Copies to States

Stakeholder	Model 1	Model 2
SQG	1,549,124	1,549,124
LQG	2,527,517	2,527,517
Small TSDF	346	346
Medium TSDF	1,730	1,730
Large TSDF	4,844	4,844
Transporter(s)	0	0
State(s)	0	0
EPA	0	48,000

EMPLOYEE TRAINING

The DOT requirement that each waste handler involved in manifest preparation provide training to employees who prepare manifests will continue. Arguments could be made that there may be either greater or lesser training costs in an electronic environment. For simplicity's sake, we have left them the same.

Annual Cost

Table 5-6 shows total annual costs for employee training in the "to-be" environment.

Table 5-6. "To-Be" Employee Training Costs

Stakeholder	Model 1	Model 2
SQG	299,092	299,092
LQG	2,402,534	2,402,534
Small TSDF	80,098	80,098
Medium TSDF	400,492	400,492
Large TSDF	1,121,378	1,121,378
Transporter(s)	5,600,138	5,600,138
State(s)	0	0
EPA	0	0

INFORMATION SYSTEMS

Information systems require constant upkeep and maintenance. Vendors of commercial software and hardware frequently charge as much as 20 percent of the system's initial design and development cost. Additionally, any living system is enhanced over time. Hardware is also periodically replaced and enhanced. This section reflects the cost of "to-be" information system management, which generally will be greater than that of "as-is" systems—reflecting their greater complexity.

If the volume of reporting through the CDX exceeds the capacity of the CDX's communication circuits, the CDX may have to expand its communications bandwidth. The additional telecommunication costs would be a direct Operations and Maintenance (O&M) cost attributable to manifest reporting. Unless electronic reporting of manifest experiences phenomenal acceptance, the additional communications requirement is not expected to surpass the CDX's planned communications bandwidth, so we have not factored any additional O&M costs into the cost data.

Annual Cost

Table 5-7 shows total annual costs for information systems in the "to-be" environment.

Table 5-7. "To-Be" Information Technology Cost

Stakeholder	Model 1	Model 2
SQG	68,781,864	68,781,864
LQG	149,849,970	149,849,970
Small TSDF	489,133	489,133
Medium TSDF	2,169,090	2,169,090
Large TSDF	467,309	467,309
Transporter(s)	108,000	108,000
State(s)	2,315,760	1,857,408
EPA	0	150,000

SECURITY

This section presents the annual cost to manage and maintain the security (electronic signature) portion of the "to-be" system. The cost for this area varies dramatically between the submodels. The cost for each submodel is the same, however, under Model 1 as under Model 2.

The costs in this section reflect not only the cost of managing and maintaining hardware and software but also costs associated with turnover in personnel and organizations—of which the security system keeper may need to keep constant track (depending on the submodel).

Model 1—TSDF Direct to State

MODEL 1A—SOFTWARE PKI

Certificate issuance is an O&M cost that the TSDF will have to bear. As personnel rotate, new personnel will require certificates that allow them to interact with the system. Personnel turnover is expected to be approximately 12 percent per year. Personnel who remain on the task will have to renew their certificates prior to expiration. If the digital signature software solution is a COTS product, the TSDF also will be paying for software maintenance annually. We have factored these costs into our estimates in Table 5-8.

MODEL 1B—HARDWARE TOKEN PKI

In addition to the costs cited in Model 1A, replacement personnel in Model 1B will require issuance of a hardware token that contains a private key, as well as a reader to interrogate the token. The hardware tokens can be recycled; they must be reprogrammed for the new owner, however. FORTEZZA cards (which are used by SecurEC), must be reprogrammed at the certificate authority facility, so there is a recurring cost for postage, insurance, and issuance of a new certificate on a recycled hardware token. Failure of electronic components such as hardware

tokens is inevitable, so the costs in Table 5-8 incorporate an allowance for hardware replacement.

MODEL 1C—DIGITIZED SIGNATURE

In Model 1C, replacement personnel require the issuance of a digitizing pad that allows the user to capture the digitized signature. As a general rule, replacement personnel should be able to use the digitizing pad of their predecessor, so hardware costs should not vary significantly from year to year. Failure of electronic components such as digitizing pads is inevitable, so the costs in Table 5-8 incorporate an allowance for hardware replacement.

MODEL 1D—NO DIGITAL SIGNATURE

There are no additional annual security cost factors for this approach.

Model 2—TSDF to State Through CDX

MODEL 2A—SOFTWARE PKI

Certificate issuance is an O&M cost that the TSDF will have to bear. As personnel rotate, new personnel will require certificates that allow them to interact with the system. Personnel turnover is expected to be approximately 12 percent per year. Personnel who remain on the task will have to renew their certificates prior to expiration. If the digital signature software solution is a COTS product, the TSDF also will be paying for software maintenance annually. We have factored these costs into our estimates in Table 5-8.

MODEL 2B—HARDWARE TOKEN PKI

In addition to the cost cited in Model 2A, replacement personnel in Model 1B will require issuance of the hardware token that contains a private key, as well as a reader to interrogate the token. The hardware tokens can be recycled; they must be reprogrammed for the new owner, however. FORTEZZA cards (which are used by SecurEC must be reprogrammed at the certificate authority facility, so there is a recurring cost for postage, insurance, and issuance of a new certificate on a recycled hardware token. Failure of electronic components such as hardware tokens is inevitable, so the costs in Table 5-8 incorporate an allowance for hardware replacement.

MODEL 2C—DIGITIZED SIGNATURE

Replacement personnel in Model 2C will also require issuance of a digitizing pad that allows the user to capture the digitized signature. As a general rule, replacement personnel should be able to use the digitizing pad of their predecessor, so hardware costs should not vary significantly from year to year. Failure of elec-

tronic components such as digitizing pads is inevitable, so the costs in Table 5-8 incorporate an allowance for hardware replacement.

MODEL 2D—NO ELECTRONIC SIGNATURE

There are no additional annual security costs for this approach.

Annual Cost

Table 5-8 shows total annual costs for security under each of the eight sub-models.

Table 5-8. Total National Annual Costs for Security by Stakeholder Type

Stakeholder Type	Model							
	1A	1B	1C	1D	2A	2B	2C	2D
SQG	0	0	0	0	0	0	0	0
LQG	0	0	0	0	0	0	0	0
Small TSDF	37,500	750,000	116,875	0	37,500	750,000	116,875	0
Medium TSDF	1,518,206	15,000,000	637,500	0	1,518,206	15,000,000	637,500	0
Large TSDF	151,821	1,500,000	63,750	0	151,821	1,500,000	63,750	0
Transporter(s)	0	0	0	0	0	0	0	0
State(s)	0	0	0	0	0	0	0	0
EPA	0	0	0	0	0	0	0	0

SUMMARY

Table 5-9 provides a summary of the total annual cost for each stakeholder.

Table 5-9. Summary Annual Cost for Each Stakeholder ($000)

Stakeholder	Model							
	1A	1B	1C	1D	2A	2B	2C	2D
SQG	75,923	75,923	75,923	75,923	75,923	75,923	75,923	75,923
LQG	159,559	159,559	159,559	159,559	161,672	161,672	161,672	161,672
Small TSDF	3,375	4,088	3,454	3,338	3,375	4,088	3,454	3,338
Medium TSDF	17,929	31,411	17,049	16,411	17,929	31,411	17,049	16,411
Large TSDF	40,497	41,845	40,409	40,345	40,497	41,845	40,409	40,345
Transporter(s)	15,721	15,721	15,721	15,721	15,721	15,721	15,721	15,721
State(s)	3,699	3,699	3,699	3,699	2,549	2,549	2,549	2,549
EPA	0	0	0	0	1,581	1,581	1,581	1,581
Total	316,703	332,246	315,814	314,996	319,247	334,789	318,357	317,539

Table 5-10 shows the unit costs per manifest for Model 1, excluding any security costs.

Table 5-10. "To-Be" Costs for Model 1, Excluding Security

	Prepara-tion	Transmission	Record-keeping	Acquisi-tion	Submission to States	Employee training	Information technology	Total
LQGs	0.00	0.10	0.26	0.13	2.18	1.99	122.39	130.42
SQGs	1.97	0.27	0.75	0.38	2.18	0.32	73.96	79.84
Small TSDFs	10.19	8.49	0.46	0.25	1.52	5.41	33.05	59.38
Medium TSDFs	10.19	8.49	0.46	0.25	1.52	5.41	29.31	55.64
Large TSDFs	10.19	8.49	0.46	0.25	1.52	5.41	2.26	28.58
Transporters	27.58	2.16	0.96	0.25	0.00	71.41	0.00	102.36
States	0.00	0.00	0.46	0.00	0.00	0.00	0.95	1.41
EPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total cost	63.51	28.01	3.80	1.52	8.91	89.96	261.91	457.63

Table 5-11 shows the unit costs per manifest for Model 2, excluding any security costs.

Table 5-11. "To-Be" Costs for Model 2, Excluding Security

	Preparation	Transmis-sion	Record-keeping	Acquisi-tion	Submission to States	Employee Training	Information Technology	Total
LQGs	3.37	0.10	0.26	0.13	2.18	1.99	124.14	$132.17
SQGs	1.97	0.27	0.75	0.38	2.18	0.32	73.96	$79.84
Small TSDFs	10.19	8.49	0.46	0.25	1.52	5.41	33.05	$59.38
Medium TSDFs	10.19	8.49	0.46	0.25	1.52	5.41	$29.31	$55.64
Large TSDFs	10.19	8.49	0.46	0.25	1.52	5.41	$2.26	$28.58
Transporters	27.58	2.16	0.96	0.25	0.00	71.41	$0.00	$102.36
States	0.00	0.00	0.23	0.00	0.00	0.00	$0.76	$0.99
EPA	0.00	0.00	0.46	0.00	0.00	0.00	$0.06	$0.52
Total cost	63.51	28.01	4.03	1.52	8.91	89.96	$263.54	$459.48

Comparing the unit costs in Tables 5-10 and 5-11 with the unit costs shown for the As-Is model in Table 3-9, we estimate the following total savings per stakeholder.

Table 5-12. Unit Cost Savings Over As-Is Model

	Model 1 savings	Model 2 savings
LQGs	$7.15	$5.40
SQGs	$9.52	$9.52
Small TSDFs	$18.95	$18.95
Medium TSDFs	($4.69)	($4.69)
Large TSDFs	$20.70	$20.70
Transporters	$14.99	$14.99
States	$8.20	$8.62
EPA	$0.00	($0.52)
Total Savings	$74.82	$72.96

Chapter 6
Analysis and Conclusions

The purpose of this chapter is to analyze the manifest process in terms of costs and benefits. The analysis should be used as a guide to the various technologies available as well as to provide a business case and return on investment that will support EPA decisions to move toward electronic reporting.

TEN-YEAR COSTS

Advantages of Electronic Manifests Versus the "As-Is" Paper Process

The costs of the "as-is" system compared to the most likely investments to be made by each stakeholder in the first Model are shown in Table 6-1. As shown in Table 6-1, implementing Model 1 can save an aggregate total of over $1 billion.

Table 6-1. Comparison of Model 1 "To-Be" with "As-Is" Costs ($000)

	ten-year cost	"To-Be" Infrastructure investment	"To-Be" security investment	"To-Be" ten-year operating cost	"To-Be" Life cycle cost	Savings
LQGs	1,726,481	68,588	0	1,595,590	1,664,178	62,303
SQGs	830,273	0	0	759,226	759,226	71,047
Small TSDFs	56,304	462	400	33,751	34,613	21,691
Medium TSDFs	260,284	1,425	4,353	179,295	185,073	75,211
Large TSDFs	725,345	679	435	404,972	406,086	319,259
Transporters	445,589	0	0	157,210	157,210	288,379
States	233,891	1,258	0	36,988	38,246	195,646
EPA	0	0	0	0	0	0
Total	4,278,167	72,411	5,188	3,167,032	3,244,631	1,033,536

These savings are obtained through:

- elimination of keying and rekeying of data into isolated information systems.
- Receiving, routing reproducing, sorting, filing, holding, and mailing or faxing copies, and other manual efforts associated with the paper manifest

The savings in these areas more than offset the cost of building and maintaining EC systems that link the stakeholder.

Table 6-2 shows the ten-year costs for Model 2. This model is the same for industry, but indicates that if the EPA were to do the programming necessary to provide the manifest to the various states in the format that they currently use that the states would save approximately $12 million over ten years at a cost to the EPA of nearly $17 million. This results in a net cost of less than $0.5 million a year. However, if the states found it necessary to change their programs any ways to reflect changes in data elements or for other reasons, their gain would be dramatically reduced.

Table 6-2. Comparison of Model 2 "To-Be" with "As-Is" Costs ($000s)

	ten-year cost	"To-Be" Infrastructure investment	"To-Be" security investment	"To-Be" ten-year operating cost	"To-Be" life cycle cost	Savings
LQGs	1,726,481	68,588	0	1,595,590	1,664,178	62,303
SQGs	830,273	0	0	759,226	759,226	71,047
Small TSDFs	56,304	462	400	33,751	34,613	21,691
Medium TSDFs	260,284	1,425	4,353	179,295	185,073	75,211
Large TSDFs	725,345	679	435	404,972	406,086	319,259
Transporters	445,589	0	0	157,210	157,210	288,379
States	233,891	1,010	0	25,489	26,500	207,392
EPA	0	1,003	0	15,810	16,813	(16,813)
Total	4,278,167	73,167	5,188	3,171,343	3,249,698	1,028,468

QUALITATIVE ADVANTAGES

In addition to the net savings in going to electronic hazardous waste manifesting, there are a number of very important qualitative advantages as well. A few of these are:

- *Data is more timely.* Information will move between the participating stakeholders much more quickly. This is important in an environment where the waste is physically moving between stakeholders.

- *Better information for generators.* The generators are most often either actually or perceptually liable for any problems that occur with the movement and disposable of their waste. They are therefore often very interested in knowing its status. EC will provide them far more reliable and timely data of the exact location, status, and treatment of their waste.

- *Data will be more accurate*. Eliminating multiple keying efforts will reduce data errors. EC across the trading partners may also increase the use of bar-coding. Currently, many TSDFs use barcodes on waste containers on-site. However, currently no single barcode is applied to the waste container to track the waste from the generators through transportation, or to all TSDFs. Adoption of EC will encourage standard barcoding and eventually transmission chips on waste containers.

- *Increase participation and standardizaton.* The original uniform hazardous waste manifest had a required uniform minimum number of data elements, but allows for each of the 24 states to have their own data elements and codes. Having worked with this disjointed process the new proposed rule includes a truly standard manifest. This will accrue further savings which are not identified in our analysis and may also encourage additional states to participate.

ANALYSIS OF ELECTRONIC SIGNATURE ALTERNATIVES

Table 6-3 illustrates the 10 year life-cycle savings on the four approaches to electronic signatures. Using hardware based PKI is the most expensive at $27 million a year and is clearly not cost effective. Further, with the difficulties experienced in EPA testing of adding PKI hardware (card readers) to user machines, this option becomes very unappealing. Not surprisingly the non-technical—continue to sign the manifest option is the cheapest. However, the savings are only $13 to $22 million total over the 10 years against the two likely electronic options.

Table 6-3. Comparison of Electronic Signature Alternatives ($)

	Cost elements	Software PKI	Hardware PKI	Digitized signatures	None
Small TSDFs	Investment cost	400,000	4,640,000	687,500	0
	10-year recurring cost	375,000	7,500,000	1,168,750	0
	Life-cycle cost	775,000	12,140,000	1,856,250	0
Medium TSDFs	Investment cost	4,353,000	88,400,000	3,750,000	0
	10-year recurring cost	15,182,060	150,000,000	6,375,000	0
	Life-cycle cost	19,535,060	238,400,000	10,125,000	0
Large TSDFs	Investment cost	435,300	8,840,000	375,000	0
	10-year recurring cost	1,518,206	15,000,000	637,500	0
	Life-cycle cost	1,953,506	23,840,000	1,012,500	0
Total all	Life-cycle cost	22,263,566	274,380,000	12,993,750	0

Of the remaining two categories in Table 6-3, software-based PKI is the more expensive—nearly $1 million dollars a year more than digitizing pads. Software-based PKI is, however, easier to implement across the breadth of trading partners and requires no special hardware. It will also be complementary to the implementation of software based PKI in other EPA and state EC efforts. Software PKI also tends to more closely bind the signature to the data than a digitized signature. Lastly, digital signatures are recognized in most state electronic signature laws, however, digitized signatures are not. Disadvantages to software based PKI include issuing and maintaining the identity proofing and certificates amongst the large number of participating individuals will be a major undertaking in this proc-

ess. This recurring cost including the specific cost to re-issue third party certificates drives up the life-cycle cost for this option.

Advantages to using digitized pads, beyond the lower costs include not having to manage the security record keeping since the employee's digitized signature can stand alone. Some attorneys also believe the digitized image will be easier to convince a jury with over the "mathematics" of a PKI signature. However, the burden and difficulty of maintaining the digitizing pads and pens may place an undue burden upon smaller transporters and TSDFs as they cannot obtain economies of scale.

Collectively these arguments would weigh in slightly in favor of using software based PKI as the best means of implementing EC for hazardous waste manifests.

BENEFIT-COST ANALYSIS

By examining the difference between the to-be costs using a software-based PKI approach versus the as-is cost of HWM processing, we can quantify the tangible benefits of the investment.

Model 1 Benefit-Cost Analysis

Table 6-4 illustrates the total costs and total tangible benefits of the investment in Hazardous Waste Manifest automation from FY01 through FY10 for Model 1. It also shows the costs discounted at 7 percent. The costs are discounted on the assumption that costs are incurred and benefits accrue throughout each year.

Table 6-4. Model 1 Benefit-Cost Analysis

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Costs											
LQGs	$148.4	$159.6	$159.6	$159.6	$159.6	$159.6	$159.6	$159.6	$159.6	$159.6	$1,584.4
SQGs	$38.0	$75.9	$75.9	$75.9	$75.9	$75.9	$75.9	$75.9	$75.9	$75.9	$721.3
Small TSDFs	$2.5	$3.4	$3.4	$3.4	$3.4	$3.4	$3.4	$3.4	$3.4	$3.4	$32.9
Medium TSDFs	$14.7	$17.9	$17.9	$17.9	$17.9	$17.9	$17.9	$17.9	$17.9	$17.9	$176.1
Large TSDFs	$21.4	$40.5	$40.5	$40.5	$40.5	$40.5	$40.5	$40.5	$40.5	$40.5	$385.8
Transporters	$7.9	$15.7	$15.7	$15.7	$15.7	$15.7	$15.7	$15.7	$15.7	$15.7	$149.3
States	$3.1	$3.7	$3.7	$3.7	$3.7	$3.7	$3.7	$3.7	$3.7	$3.7	$36.4
EPA	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total costs	$236.0	$316.7	$316.7	$316.7	$316.7	$316.7	$316.7	$316.7	$316.7	316.7	$3,086.3
Discount factor	0.9667	0.9035	0.8444	0.7891	0.7375	0.6893	0.6442	0.6020	0.5626	0.5258	—
Discounted costs	$228.1	$286.1	$267.4	$249.9	$233.6	$218.3	$204.0	$190.7	$178.2	$166.5	$2,222.9
Benefits											
LQGs	$86.3	$172.6	$172.6	$172.6	$172.6	$172.6	$172.6	$172.6	$172.6	$172.6	$1,640.2
SQGs	$41.5	$83.0	$83.0	$83.0	$83.0	$83.0	$83.0	$83.0	$83.0	$83.0	$788.8
Small TSDFs	$2.8	$5.6	$5.6	$5.6	$5.6	$5.6	$5.6	$5.6	$5.6	$5.6	$53.5
Medium TSDFs	$13.0	$26.0	$26.0	$26.0	$26.0	$26.0	$26.0	$26.0	$26.0	$26.0	$247.3
Large TSDFs	$36.3	$72.5	$72.5	$72.5	$72.5	$72.5	$72.5	$72.5	$72.5	$72.5	$689.1
Transporters	$22.3	$44.6	$44.6	$44.6	$44.6	$44.6	$44.6	$44.6	$44.6	$44.6	$423.3
States	$11.7	$23.4	$23.4	$23.4	$23.4	$23.4	$23.4	$23.4	$23.4	$23.4	$222.2
EPA	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total benefits	$213.9	$427.8	$427.8	$427.8	$427.8	$427.8	$427.8	$427.8	$427.8	$427.8	$4,064.3
Discount factor	0.9667	0.9035	0.8444	0.7891	0.7375	0.6893	0.6442	0.6020	0.5626	0.5258	
Discounted benefits	$206.8	$386.5	$361.2	$337.6	$315.5	$294.9	$275.6	$257.6	$240.7	$225.0	$2,901.4
Net discounted benefits	($21.3)	$100.4	$93.8	$87.7	$81.9	$76.6	$71.6	$66.9	$62.5	$58.4	$678.5
Benefit-cost ratio	0.9066	1.3508	1.3508	1.3508	1.3508	1.3508	1.3508	1.3508	1.3508	1.3508	1.3053

We computed the discounted costs by multiplying the annual costs by the discount rate for each year. The discount rate is defined by OMB, in Circular A-94, as follows:

> Discount Rate Policy. In order to compute net present value, it is necessary to discount future benefits and costs. This discounting reflects the time value of money. Benefits and costs are worth more if they are experienced sooner. All future benefits and costs, including non-monetized benefits and costs, should be discounted. The higher the discount rate, the lower is the present value of future cash flows. For typical investments, with costs concentrated in early periods and benefits following in later periods, raising the discount rate tends to reduce the net present value…

a. Real versus Nominal Discount Rates. The proper discount rate to use depends on whether the benefits and costs are measured in real or nominal terms.

A real discount rate that has been adjusted to eliminate the effect of expected inflation should be used to discount constant-dollar or real benefits and costs. A real discount rate can be approximated by subtracting expected inflation from a nominal interest rate.

A nominal discount rate that reflects expected inflation should be used to discount nominal benefits and costs. Market interest rates are nominal interest rates in this sense.

We used the real discount rate for our analysis, so we did not need to factor in inflation. The magnitude of the real discount rate reflects the time value of money, in that money today is worth more than money tomorrow (you could put it in the bank and get interest). The nominal discount rate is the real discount rate plus expected inflation.

The mid-year discount rate can be calculated by the formula $1/(1+I)^{(n-0.5)}$ where n represents the year and I represents the interest rate (in this case, 0.070).

The comparison above demonstrates that the benefits substantially outweigh the costs of the system from FY01 through FY10. The benefit/cost ratio—discounted benefits divided by discounted costs—is 1.3053, which basically means that, in the aggregate, the nation is getting $1.31 in benefits for every dollar spent for the 10-year period. That is a ROI of 0.3053, which would normally be expressed as 30.53 percent. The payback period for this investment is 1.212 years.

Model 2 Benefit-Cost Analysis

Under Model 2, we project that most costs to the stakeholders and all benefits will remain unchanged from Model 1. The major difference is that EPA will make an investment in the process, which in turn will lower the states' investment and operating costs. The benefit-cost analysis for Model 2 is shown in Table 6-5.

Table 6-5. Model 2 Benefit Cost Analysis

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
Costs											
LQGs	$148.4	$159.6	$159.6	$159.6	$159.6	$159.6	$159.6	$159.6	$159.6	$159.6	$1,584.4
SQGs	$38.0	$75.9	$75.9	$75.9	$75.9	$75.9	$75.9	$75.9	$75.9	$75.9	$721.3
Small TSDFs	$2.5	$3.4	$3.4	$3.4	$3.4	$3.4	$3.4	$3.4	$3.4	$3.4	$32.9
Medium TSDFs	$14.7	$17.9	$17.9	$17.9	$17.9	$17.9	$17.9	$17.9	$17.9	$17.9	$176.1
Large TSDFs	$21.4	$40.5	$40.5	$40.5	$40.5	$40.5	$40.5	$40.5	$40.5	$40.5	$385.8
Transporters	$7.9	$15.7	$15.7	$15.7	$15.7	$15.7	$15.7	$15.7	$15.7	$15.7	$149.3
States	$2.3	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$25.2
EPA	$1.0	$1.6	$1.6	$1.6	$1.6	$1.6	$1.6	$1.6	$1.6	$1.6	$15.2
Total costs	$236.1	$317.1	$317.1	$317.1	$317.1	$317.1	$317.1	$317.1	$317.1	$317.1	$3,090.4
Discount factor	0.9667	0.9035	0.8444	0.7891	0.7375	0.6893	0.6442	0.6020	0.5626	0.5258	—
Discounted costs	$228.3	$286.5	$267.8	$250.3	$233.9	$218.6	$204.3	$190.9	$178.4	$166.8	$2,225.8
Total benefits (From Table 6-4)	$213.9	$427.8	$427.8	$427.8	$427.8	$427.8	$427.8	$427.8	$427.8	$427.8	$4,064.3
Discount factor	0.9667	0.9035	0.8444	0.7891	0.7375	0.6893	0.6442	0.6020	0.5626	0.5258	—
Discounted benefits	$206.8	$386.5	$361.2	$337.6	$315.5	$294.9	$275.6	$257.6	$240.7	$225.0	$2,901.4
Net discounted benefits	($21.5)	$100.0	$93.5	$87.3	$81.6	$76.3	$71.3	$66.6	$62.3	$58.2	$675.6
Benefit-cost ratio	0.9058	1.3490	1.3490	1.3490	1.3490	1.3490	1.3490	1.3490	1.3490	1.3490	1.3036

The comparison above demonstrates that the benefits substantially outweigh the costs of the system from FY01 through FY10. The benefit/cost ratio—discounted benefits divided by discounted costs—is 1.3036, which basically means that, in the aggregate, the nation is getting $1.30 in benefits for every dollar spent for the 10-year period. That is a ROI of 0.3036, which would normally be expressed as 30.36 percent. The payback period for this investment is 1.215 years.

CONCLUSION

The results of this economic analysis only reinforce the common sense opinion that the time for electronic compliance reporting has come. The need to move manifest data quickly and accurately amongst this diverse stakeholder community virtually demands that it be done.

However, given that environmental compliance reporting is only one function of the hazardous waste manifest—the others being its DOT role and its use as a commercial document justifies the approach of the proposed rule that the EPA act as an implementing agent and standards/requirements manager rather than being the prime mover.

As indicated above, between software based PKI and digitized signatures, money does not heavily favor one over another, but some of the qualitative issues suggest implementing software based PKI.

Appendix A
"As-Is" Annual Cost Detail

The detailed analysis of the "as-is" process replicates and summarizes the data in the "Regulatory Assessment of Proposed Modifications to the Resource Conservation and Recovery Act (RCRA) Manifest System and the Utility Consolidation Exemption—Draft Report" dated February 16, 2000. We have made additional assumptions about the waste handlers' existing information technology systems and security to supplement the regulatory assessment.

MANIFEST PREPARATION

The manifest preparation costs for large quantity generators are shown in Table A-1.

Table A-1. Manifest Preparation Costs for Large Quantity Generators

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor rate	Total cost per year	Unit cost per manifest
Initial Manifest Completion With Assistance from TSDFs						
Complete the Manifest	506,999	0.03	15,210	$45.20	$687,491	$1.36
Initial Manifest Completion Without Assistance from TSDFs						
Complete the Manifest—Federal	35,007	0.83	29,056	$45.20	$1,313,323	$37.52
Complete the Manifest—State	26,995	0.30	8,099	$45.20	$366,052	$13.56
Repeat Manifest Completion Without Assistance from TSDFs						
Complete the Manifest—Federal	665,134	0.40	266,054	$45.20	$12,025,623	$18.08
Complete the Manifest—State	512,153	0.12	61,458	$45.20	$2,777,918	$5.42
Continuation Sheet Completion Without Assistance from TSDFs						
Complete the Manifest—Federal	33,257	0.17	5,654	$45.20	$255,547	$7.68
Complete the Manifest—State	25,608	0.08	2,049	$45.20	$92,599	$3.62
Subtotal LQGs	1,805,153				$17,518,551	$9.70

The manifest preparation costs for small quantity generators are shown in Table A-2.

Table A-2. Manifest Preparation Costs for Small Quantity Generators

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor rate	Total cost per year	Unit cost per manifest
Initial manifest completion with assistance from TSDFs						
Complete the manifest (Automated As-Is)	185,994	0.03	5,580	$45.20	$252,207	$1.36
Complete the manifest (Manual As-Is)	557,981	0.03	16,739	$45.20	$756,622	$1.36
Initial manifest completion without assistance from TSDFs						
Complete the manifest—Federal (automated as-is)	2,325	0.79	1,837	$45.20	$83,021	$35.71
Complete the manifest—Federal (manual as-is)	6,975	0.79	5,510	$45.20	$249,063	$35.71
Complete the manifest—State (automated as-is)	1,790	0.29	519	$45.20	$23,467	$13.11
Complete the manifest—State (manual as-is)	5,371	0.29	1,558	$45.20	$70,400	$13.11
Repeat manifest completion without assistance from TSDFs						
Complete the manifest—Federal (automated as-is)	44,174	0.38	16,786	$45.20	$758,724	$17.18
Complete the manifest—Federal (manual as-is)	132,521	0.38	50,358	$45.20	$2,276,172	$17.18
Complete the manifest—State (automated as-is)	34,014	0.11	3,741	$45.20	$169,115	$4.97
Complete the manifest—State (manual as-is)	102,041	0.11	11,224	$45.20	$507,345	$4.97
Continuation Sheet Completion without assistance from TSDFs						
Complete the manifest—Federal (automated as-is)	2,209	0.16	353	$45.20	$15,974	$7.23
Complete the manifest—Federal (manual as-is)	6,626	0.16	1,060	$45.20	$47,921	$7.23
Complete the manifest—State (automated as-is)	1,701	0.08	136	$45.20	$6,150	$3.62
Complete the manifest—State (manual as-is)	5,102	0.08	408	$45.20	$18,450	$3.62

The manifest preparation costs for transporters are shown in Table A-3.

Table A-3. Manifest Preparation Costs for Transporters

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor rate	Total cost per year	Unit cost per manifest
Federal						
Complete initial manifest	44,307	1.00	44,307	$45.20	$2,002,676	$45.20
State						
Complete initial manifest	34,116	0.17	5,800	$45.20	$262,147	$7.68

The manifest preparation costs for commercial TSDFs are shown in Table A-4.

Table A-4. Manifest Preparation Costs for Commercial TSDFs

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor rate	Total cost per year	Unit cost per manifest
Complete initial manifest—Federal	62,549	1.00	62,549	$45.20	$2,827,215	$45.20
Complete initial manifest—State	48,162	0.17	8,188	$45.20	$370,077	$7.68
Complete repeat manifest—Federal	210,496	0.32	67,359	$45.20	$3,044,614	$14.46
Complete repeat manifest—State	162,082	0.17	27,554	$45.20	$1,245,438	$7.68
Complete Continuation Sheet—Federal	10,525	0.17	1,789	$45.20	$80,874	$7.68
Complete Continuation Sheet—State	8,104	0.08	648	$45.20	$29,304	$3.62
Manifests prepared for generators—Federal	1,250,973	0.32	400,311	$45.20	$18,094,073	$14.46
Manifests prepared for generators—State	963,249	0.17	163,752	$45.20	$7,401,605	$7.68
Manifests prepared for rejected loads—Federal	8,096	0.24	1,943	$45.20	$87,825	$10.85
Manifests prepared for rejected loads—State	6,234	0.04	249	$45.20	$11,271	$1.81
Continuation Sheets prepared for generators—Federal	62,549	0.17	10,633	$45.20	$480,627	$7.68
Continuation Sheets prepared for generators—State	48,162	0.08	3,853	$45.20	$174,154	$3.62
Continuation Sheets prepared for rejected loads—Federal	405	0.02	8	$45.20	$366	$0.90
Continuation Sheets prepared for rejected loads—State	312	0.01	3	$45.20	$141	$0.45

The manifest preparation costs for captive TSDFs are shown in Table A-5.

Table A-5. Manifest Preparation Costs for Captive TSDFs

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor rate	Total cost per year	Unit cost per manifest
Complete initial manifest—Federal	3,871	0.89	3,445	$45.20	$155,723	$40.23
Complete initial manifest—State	2,981	0.32	954	$45.20	$43,117	$14.46
Complete repeat manifest—Federal	73,547	0.43	31,625	$45.20	$1,429,459	$19.44
Complete repeat manifest—State	56,631	0.13	7,362	$45.20	$332,764	$5.88
Complete Continuation Sheet—Federal	3,677	0.18	662	$45.20	$29,916	$8.14
Complete Continuation Sheet—State	2,832	0.08	227	$45.20	$10,241	$3.62

The total manifest preparation costs for both commercial and captive TSDFs were allocated among small, medium and large TSDFs proportional to the number of manifests processed. For purposes of our analysis, we assumed that small TSDFs process 5 percent of the manifests, medium TSDFs process 25 percent of the manifests, and large TSDFs process 70 percent of the manifests. The allocation of preparation costs among the sizes of TSDFs is shown in Table A-6.

Table A-6. Allocation of TSDF Costs by Size

	Number of manifests	Total cost	Unit cost
Small TSDF	149,272	$1,792,440	$12.01
Medium TSDF	746,359	$8,962,201	$12.01
Large TSDF	2,089,806	$25,094,163	$12.01

In addition to the costs shown above in the regulatory assessment, we have estimated the costs borne by TSDFs to re-key manifests prepared by automated generators. For small TSDFs, these costs are assumed to be zero, since none are assumed to be automated in current environment. For medium TSDFs, these costs are shown in Table A-7.

Table A-7. Medium TSDF Re-Keying Costs

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor rate	Total cost per year	Unit cost per manifest
Initial						
Complete the manifest (manual as-is)	139,495	0.03	4,185	$45.20	$189,155	$1.36
Complete the manifest—Federal (manual as-is)	1,744	0.79	1,378	$45.20	$62,266	$35.71
Complete the manifest—State (manual as-is)	1,343	0.29	389	$45.20	$17,600	$13.11
Repeat						
Complete the manifest—Federal (manual as-is)	33,130	0.38	12,589	$45.20	$569,043	$17.18
Complete the manifest—State (manual as-is)	25,510	0.11	2,806	$45.20	$126,836	$4.97
Continuation Sheet						
Complete the manifest—Federal (manual as-is)	1,657	0.16	265	$45.20	$11,980	$7.23
Complete the manifest—State (manual as-is)	1,276	0.08	102	$45.20	$4,612	$3.62

For large TSDFs, the re-keying costs are shown in Table A-8.

Table A-8. Large TSDF Re-Keying Costs

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor rate	Total cost per year	Unit cost per manifest
Initial						
Complete the manifest (manual as-is)	390,586	0.03	11,718	$45.20	$529,635	$1.36
Complete the manifest—Federal (manual as-is)	4,883	0.79	3,857	$45.20	$174,344	$35.71
Complete the manifest—State (manual as-is)	3,760	0.29	1,090	$45.20	$49,280	$13.11
Repeat						
Complete the manifest—Federal (manual as-is)	92,764	0.38	35,250	$45.20	$1,593,320	$17.18
Complete the manifest—State (manual as-is)	71,428	0.11	7,857	$45.20	$355,142	$4.97
Continuation Sheet						
Complete the manifest—Federal (manual as-is)	4,638	0.16	742	$45.20	$33,545	$7.23
Complete the manifest—State (manual as-is)	3,572	0.08	286	$45.20	$12,915	$3.62

The total As-Is manifest preparation costs for TSDFs is the sum of the costs shown in the regulatory assessment and the additional re-keying costs. The total costs for each size of TSDF is shown in Table A-9.

Table A-9. Total TSDF Costs for Manifest Preparation ($)

	Regulatory assessment	Re-keying costs	Total cost	Unit cost
Small TSDF	1,792,440	0	1,792,440	12.01
Medium TSDF	8,962,201	981,493	9,943,694	13.32
Large TSDF	25,094,163	2,748,181	27,842,344	13.32

MANIFEST TRANSMISSION

Total transmission costs for large generators are shown in Table A-10

Table A-10. Transmission Costs for Large Generators

	Number of manifest	Burden per mani-fest (hours)	Total burden (hours)	Labor rate	Total labor cost per year	Post-age	Total postage per year	Total cost per year	Unit cost per manifest
Copy the manifest	1,207,140	0.01	12,071	$53.00	$639,784	$0.00	$0	$639,784	$0.53
Transmit the manifest (rail and water carload)	35,852	0.20	7,170	$27.00	$193,601	$11.00	$394,372	$587,973	$16.40
Total LQGs	1,242,992							$1,227,757	$0.99

Total transmission costs for small generators are shown in Table A-11.

Table A-11. Transmission Costs for Small Generators

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor rate	Total labor cost per year	Postage	Total postage per year	Total cost per year	Unit cost per manifest
Copy the manifest	929,968	0.01	9,300	$53.00	$492,883	$0	$0	$492,883	$0.53
Transmit the manifest (rail and water carload)	27,620	0.20	5,524	$27.00	$149,148	$11	$303,820	$452,968	$16.40
Total SQGs	957,588							$945,851	$0.99

Total transmission costs for transporters are shown in Table A-12.

Table A-12. Transmission Costs for Transporters

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor Rate	Total labor cost per year	Post-age	Total postage per year	Total cost per year	Unit cost per manifest
Copy the manifest	2,433,118	0.17	413,630	$53.00	$21,922,393	$0.00	$0	$21,922,393	$9.01
Transmit the manifest (rail and water carload)	36,132	0.20	7,226	$27.00	$195,113	$11.00	$397,452	$592,565	$16.40
Transmit the manifest (rail and water intermodal)	7,226	0.20	1,445	$27.00	$39,020	$11.00	$79,486	$118,506	$16.40
Transmit the manifest (exports)	12,000	0.03	360	$53.00	$19,080	$0.00	$0	$19,080	$1.59
Transmit the manifest (reclamation agreements)	19,500	1.00	19,500	$53.00	$1,033,500	$0.00	$0	$1,033,500	$53.00
Total Transporters	2,507,976							$23,686,044	$9.44

Total transmission costs for TSDFs are shown in Table A-13.

Table A-13. Transmission Costs for TSDFs

	Number of manifest	Burden per manifest (hours)	Total burden (hours)	Labor Rate	Total labor cost per year	Postage	Total postage per year	Total cost per year	Unit cost per manifest
Commercial									
Copy the manifest	218,592	0.01	2,186	$53.00	$115,854	$0.00	$0	$115,854	$0.53
Transmit the manifest (rail and water carload)	6,492	0.20	1,298	$27.00	$35,057	$11.00	$71,412	$106,469	$16.40
Captive									
Copy the manifest	77,418	0.01	774	$53.00	$41,032	$0.00	$0	$41,032	$0.53
Transmit the manifest (rail and water carload)	2,299	0.20	460	$27.00	$12,415	$11.00	$25,289	$37,704	$16.40
Designated TSDFs									
Review Manifest at Delivery	2,421,118	0.17	411,590	$53.00	$21,814,273	$0.00	$0	$21,814,273	$9.01
Send copies to generators	2,421,118	0.16	387,379	$27.00	$10,459,230	$0.36	$871,602	$11,330,832	$4.68
Total TSDFs	2,717,128							$33,446,163	$12.31

The total costs we allocated to each size of TSDF are shown in Table A-14.

Table A-14. TSDF Costs for Manifest Transmission

	Number of manifests transmitted	Total cost for transmission	Unit cost per transmission
Small TSDF	135,856	$1,672,308	$12.31
Medium TSDF	679,282	$8,361,541	$12.31
Large TSDF	1,901,990	$23,412,314	$12.31

MANIFEST RECORDKEEPING

Total manifest record keeping costs for large generators are shown in Table A-15.

Table A-15.

	Number of Copies/Transmittals	Burden per Manifest	Total Burden	Labor Rate	Total Labor Cost per Year	Postage	Total Postage per year	Total Cost per year	Unit Cost per Manifest	Capital Cost of File Cabinets (per Regulatory Assessment)	Total Cost per Manifest
Recordkeeping the manifest	2,414,280	0.10	241,428	$27.00	$6,518,556	$0.00	$0	$6,518,556	$2.70		
Recordkeeping the manifest (capital cost)										$94,699	
Total LQG Recordkeeping	2,414,280							$6,518,556	$2.70	$6,613,255	$2.74

Total manifest record keeping costs for small generators are shown in Table A-16.

Table A-16.

	Number of Copies/Transmittals	Burden per Manifest	Total Burden	Labor Rate	Total Labor Cost per Year	Postage	Total Postage per year	Total Cost per year	Unit Cost per Manifest	Capital Cost of File Cabinets (per Regulatory Assessment)	Total Cost per Manifest
Recordkeeping the manifest	1,859,936	0.10	185,994	$27.00	$5,021,827	$0	$0	$5,021,827	$2.70		
Recordkeeping the manifest (capital cost)										$72,955	
Total SQG Recordkeeping	1,859,936							$5,021,827		$5,094,782	$2.74

Total manifest record keeping costs for transporters are shown in Table A-17.

Table A-17. Manifest Recordkeeping Cost for Transporters

	Number of Copies/Transmittals	Burden per Manifest	Total Burden	Labor Rate	Total Labor Cost per Year	Postage	Total Postage per year	Total Cost per year	Unit Cost per Manifest	Capital Cost of File Cabinets (per Regulatory Assessment)	Total Cost per Manifest
Place copies on file	2,433,118	0.17	413,630	$27.00	$11,168,012	$0.00	$0	$11,168,012	$4.59		
Send copies overnight to Central Office (50%)	228	0.00	0	$27.00	$0	$5,600.00	$1,276,800	$1,276,800	$5,600.00		
Send copies by mail to Central Office (50%)	55,353	0.08	4,428	$27.00	$119,562	$0.90	$49,818	$169,380	$3.06		
Recordkeeping the manifest (intermodal shipments)	7,226	0.08	578	$27.00	$15,608	$0.90	$6,503	$22,112	$3.06		
Recordkeeping the manifest (capital cost)										$92,641	
Total Tranporter Record Keeeping	2,495,925		418,636		$11,303,182		$1,333,121	$12,636,303		$12,728,944	$5.10

Total manifest record keeping costs for TSDFs are shown in Table A-18.

Table A-18. Manifest Recordkeeping Costs for TSDFs

	Number of Copies/Transmittals	Burden per Manifest	Total Burden	Labor Rate	Total Labor Cost per Year	Postage	Total Postage per year	Total Cost per year	Unit Cost per Manifest	Capital Cost of File Cabinets	Total Cost per Manifest
Commercial											
Recordkeeping the manifest	437,184	0.10	43,718	$27.00	$1,180,397	$0.00	$0	$1,180,397	$2.70		
Recordkeeping the manifest (capital cost)										$11,225,047	
Captive											
Recordkeeping the manifest	154,836	0.10	15,484	$27.00	$418,057	$0.00	$0	$418,057	$2.70		
Recordkeeping the manifest (capital cost)										$6,074	
Designated TSDFs											
Recordkeeping the manifest	2,421,118	0.17	411,590	$27.00	$11,112,932	$0.00	$0	$11,112,932	$4.59		
Total TSDFs	3,013,138		470,792		$12,711,386		$0	$12,711,386		$23,942,507	

The total manifest record keeping costs for commercial, captive, and designated TSDFs were allocated among small, medium and large TSDFs proportional to the number of manifests processed. For purposes of our analysis, we assumed that small TSDFs process 5 percent of the manifests, medium TSDFs process 25 percent of the manifests, and large TSDFs process 70 percent of the manifests. The allocation of preparation costs among the sizes of TSDFs is shown in Table A-19.

Table A-19. TSDF Cost Allocation for Manifest Recordkeeping

	Number of Records	Total Cost of Record Keeping	Unit Cost of Record Keeping
Small TSDF	150,657	$1,197,125	$7.95
Medium TSDF	753,285	$5,985,627	$7.95
Large TSDF	2,109,197	$16,759,755	$7.95

Total manifest record keeping costs for states are shown in Table A-20.

Table A-20. State Costs for Manifest Record keeping

	Number of Copies/Transmittals	Burden per Manifest	Total Burden	Labor Rate	Total Labor Cost per Year	Postage	Total Postage per year	Total Cost per year	Unit Cost per Manifest	Capital Cost of File Cabinets	Total Cost per Manifest
Recordkeeping the manifest	2,433,118	0.17	413,630	$27.00	$11,168,012	$0.00	$0	$11,168,012	$4.59		
Recordkeeping the manifest (capital cost)										$11,231,121	
Total State Record Keeping	2,433,118							$11,168,012		$22,399,133	$9.21

MANIFEST ACQUISITION

Total manifest acquisition costs for large generators are shown in Table A-21.

Table A-21. LQG Manifest Acquisition Cost

	Number of Manifests	Cost per Manifest	Total Costs of Manifests	Number of Waste Handlers	Number of Order Forms	Burden per order	Total burden	Labor and Telephone Costs	Total Cost	Cost per Manifest
Manifest form cost	350,071	$2.50	$875,178							
Acquisition cost				8,000	1.0	0.25	2000	$32.00	$64,000	
Total LQG Manifest Acquisition	350,071								$939,178	$2.68

Total manifest acquisition costs for small generators are shown in Table A-22.

Table A-22. SQG Manifest Acquisition Cost

	Number of Manifests	Cost per Manifest	Total Costs of Manifests	Number of Waste Handlers	Number of Order Forms	Burden per Order	Total Burden	Labor and Telephone Costs	Total Cost	Cost per Manifest
Manifest form cost	92,997	$2.50	$232,493							
Acquisition cost				1,552	0.4	0.25	155	$32.00	$4,966	
Total SQG Manifest Acquisition	92,997								$237,459	$2.55

Total manifest acquisition costs for transporters are shown in Table A-23.

Table A-23. Transporter Manifest Acquisition Cost

	Number of Manifests	Cost per Manifest	Total Costs of Manifests	Number of Waste Handlers	Number of Order Forms	Burden per Order	Total Burden	Labor and Telephone Costs	Total Cost	Cost per Manifest
Manifest form cost	110,767	$2.50	$276,918							
Acquisition for outbound shipments				125	2.0	0.25	63	$32.00	$2,000	
Total Transporter Manifest Acquisition	110,767								$278,918	$2.52

Total manifest acquisition costs for TSDFs are shown in Table A-24.

Table A-24. TSDF Manifest Acquisition Cost

	Number of Manifests	Cost per Manifest	Total Costs of Manifests	Number of Waste Handlers	Number of Order Forms	Burden per Order	Total Burden	Labor and Telephone Costs	Total Cost	Cost per Manifest
Commercial										
Manifest form cost	1,801,866	$2.50	$4,504,665							
Acquisition cost				253	2.0	0.25	127	$32.00	$4,048	
Captive										
Manifest form cost	77,418	$2.50	$193,545							
Acquisition cost				1,518	1.0	0.25	380	$32.00	$12,144	
Total TSDF Acquisition Cost	1,879,284								$4,714,402	$2.51

The total manifest record keeping costs for commercial and captive TSDFs were allocated among small, medium and large TSDFs proportional to the number of manifests processed. For purposes of our analysis, we assumed that small TSDFs process 5 percent of the manifests, medium TSDFs process 25 percent of the manifests, and large TSDFs process 70 percent of the manifests. The allocation of manifest acquisition costs among the sizes of TSDFs is shown in Table A-25.

Table A-25. Allocation of TSDF Manifest Acquisition Cost

	Number of manifests acquired	Total cost of manifest acquisition	Unit cost of manifest acquisition
Small TSDF	93,964	$235,720	$2.51
Medium TSDF	469,821	$1,178,601	$2.51
Large TSDF	1,315,499	$3,300,081	$2.51

SUBMISSION TO STATES

Total costs for generators to submit manifests to states are shown in Table A-26.

Table A-26. Total Cost for Generator Submission to States

	Number of Submittals	Burden per Submittal	Total Burden	Postage	Copy	Labor Rate	Total Cost
4-Part							
Regular Mail	279,809	0.16	44,769	$0.36	$0.10	$27.00	$1,337,487
Certified Mail	279,809	0.16	44,769	$2.60	$0.10	$27.00	$1,964,259
6-Part							
Regular Mail	304,140	0.16	48,662	$0.36	$0.00	$27.00	$1,423,375
Certified Mail	304,140	0.16	48,662	$2.60	$0.00	$27.00	$2,104,649
8-Part							
Regular Mail	352,802	0.16	56,448	$0.36	$0.00	$27.00	$1,651,113
Certified Mail	352,802	0.16	56,448	$2.60	$0.00	$27.00	$2,441,390
Total	1,873,502						$10,922,273

We allocated the above costs based on the relative percentage of manifests prepared by large generators (62%) versus small generators (38%). This allocation is shown in Table A-27.

Table A-27. Allocation of costs to submit to states among generators.

	Number of Manifests Submitted	Total Cost of Manifests Submitted	Unit Cost of Manifests Submitted
LQGs	1,161,571	$6,771,810	$5.83
SQGs	711,931	$4,150,464	$5.83

Total costs for TSDFs to submit manifests to states are shown in Table A-28. As in previous cost categories, we allocated costs to small, medium, and large TSDFs based on the estimated percentage of manifests prepared by each.

Table A-28. Allocation of Costs to Submit to States Among TSDFs

	Number of Sub-mittals	Burden per Submittal	Total Burden	Postage	Copy	Labor Rate	Total Cost	Unit Cost
Designated TSDF	4,554	0.16	729	$3.10	$0.00	$27.00	$33,791	
Small TSDF	228						$1,690	$7.42
Medium TSDF	1,139						$8,448	$7.42
Large TSDF	3,188						$23,653	$7.42

EMPLOYEE TRAINING

Total training costs for large and small generators are shown in Table A-29.

Table A-29. Employee training costs for generators.

	Number of Waste Handlers	Intro-ductory Burden	Refresher Burden	Total Bi-ennial Burden	Labor Rate	Total Bien-nial Cost	Total An-nual Cost (= Biennial/2 plus 10.62%)	Cost per Manifest
LQGs	8,044	4.00	2.00	48,264	$90.00	$4,343,760	$2,402,534	$1.99
SQGs	1,669	2.40	1.20	6,008	$90.00	$540,756	$299,092	$0.32

Total training costs for transporters are shown in Table A-30.

Table A-30. Employee Training Costs for Transporters

	Number of Waste Handlers	Intro-ductory Burden	Refresher Burden	Total Bi-ennial Burden	Labor Rate	Total Bien-nial Cost	Total An-nual Cost (= Bien-nial/2 plus 10.62%)	Cost per Mani-fest
Clerical	500	150.00	75.00	112,500	$90.00	$10,125,000	$5,600,138	$71.41

Total training costs for TSDFs are shown in Table A-31. As in previous cost categories, we allocated costs to small, medium, and large TSDFs based on the estimated percentage of manifests prepared by each.

Table A-31. Employee Training Costs for TSDFs

	Number of Waste Handlers	Intro-ductory Burden	Re-fresher Burden	Total Biennial Burden	Labor Rate	Total Bien-nial Cost	Total Annual Cost (= Biennial/2 plus 10.62%)	Cost per Manifest
Commercial	506	25.60	12.80	19,430	$90.00	$1,748,736	$967,226	
Captive	1,518	5.60	2.80	12,751	$90.00	$1,147,608	$634,742	
Small TSDF	101						80,098	$5.41
Medium TSDF	506						400,492	$5.41
Large TSDF	1,417						1,121,378	$5.41

INFORMATION TECHNOLOGY

Information technology costs in the current environment were estimated based on estimates of the installed information technology base in government and indus-try.

For generators, we assumed that all 18,290 large generators would have existing information systems, while only one fourth of the 71,536 small generators would have them. We assumed the average maintenance cost be 10% of the acquisition cost annually. We further assumed that only 75% of the systems would be allo-cated to Hazardous Waste Manifests, since information systems are rarely dedi-cated to a single application.

Estimated information technology costs in the current environment are shown in Table A-32.

Table A-32.

	Estimated Original Cost	Annual Mainte-nance Factor	Percent of System Allocated to HWM	Annual Mainte-nance	Number of Units	Total Cost	Number of Mani-fests	Unit Cost
LQGs	$100,000	10%	75.00%	$7,500	18,290	$137,175,000	1,207,140	$113.64
SQGs	$50,000	10%	75.00%	$3,750	17,884	$67,065,000	929,968	$72.12
Large TSDF	$1,000,000	10%	75.00%	$75,000	1	$75,000	207,207	$0.36
Medium TSDF	$100,000	10%	75.00%	$7,500	20	$150,000	74,003	$2.03
Small TSDF	$50,000	10%	75.00%	$3,750	121	$454,688	14,801	$30.72
Transporters					0	$0	0	$0.00
States	$550,000	10%	75.00%	$41,250	24	$990,000	2,433,119	$0.41

SECURITY COSTS

We estimated that there would be no security costs in the current environment.

Appendix B
"To-Be" Development Costs

BACKGROUND

This Appendix details the cost to design and develop each of the eight "to-be" submodels.

ALTERNATIVE COST ANALYSIS

Each of the eight submodels requires an investment on the part of the LQGs, the TSDFs, the states, and, in some cases, the CRF. These investments also will entail certain recurring costs for the LQGs, the TSDFs, generators, and the CRF (to the extent the CRF incurs an investment). These increased recurring costs of operations will be balanced against savings from the baseline costs identified in Chapter 3.

Investment costs for LQGs will remain the same in all scenarios. We estimated them to be $68.588 million, which represents $5,000 per facility for 75 percent of the nation's 18,290 LQGs.

Investment costs are described in the following section; a discussion of recurring costs follows. We then examine how changes from the baseline costs of operations will generate savings from these investments.

Model 1A Investment Costs

TSDF INVESTMENT COSTS

Under Model 1A, TSDFs will have to make investments in 8 areas:

- Web-hosting software
- Manifest form development
- EDI translation software
- Servers for Web applications
- Translation mapping from form format to TS 856 for state EPA
- Firewall software

- Intrusion-detection software
- 5000-seat software PKI.

Table B-1 shows small TSDF investment costs under Model 1A.

Table B-1. Small TSDF Investment Cost under Model 1A

Cost element	Estimated cost
Web-hosting software (Visual Basic)	$1,300
Manifest form development	$14,400
EDI translation software	$5,000
Access database software	$290
Application development	$50,000
Server for Web application and database	$6,500
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
500-seat software PKI (Microsoft CA)	$5,000
500 seat Signature Solution	$75,000
Subtotal—Small TSDF investment costs	$172,480

Table B-2 shows medium TSDF investment costs under Model 1A.

Table B-2. Medium TSDF Investment Cost under Model 1A

Cost element	Estimated cost
Web-hosting software (Visual Basic)	$1,300
Manifest form development	$14,400
EDI translation software	$5,000
Access database software	$290
Application development	$100,000
Server for Web application and database	$6,500
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
5000-seat software PKI (Microsoft CA)	$85,000
5000 seat Signature Solution	$350,000
Subtotal—Medium TSDF investment costs	$577,780

Table B-3 shows large TSDF investment costs under Model 1A.

Table B-3. Large TSDF Investment Cost under Model 1A

Cost element	Estimated cost
Web-hosting software (Visual Basic)	$695
Manifest form development	$14,400
EDI translation software	$38,500
Application development	$600,000
Server for Web application and database	$10,000
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	42,995
Intrusion-detection software	$8,995
5000-seat software PKI (Microsoft CA)	$85,000
5000 seat Signature Solution	$350,000
Subtotal—Large TSDF investment costs	$1,113,885

STATE INVESTMENT COSTS

Under Model 1A, states will have to make investments in four areas:

- EDI translation software to convert from 856 to state database format
- SQL database software to capture manifest data
- Loader software for flat file
- Servers to host the EDI translator.

Table B-4 shows state investment costs under Model 1A.

Table B-4. State Investment Cost under Model 1A

Cost element	Estimated cost
EDI translation software to convert from 856 to state database format	$38,500
SQL database software to capture manifest data	$3,000
Loader software for flat file	$900
Servers to host EDI translator	$10,000
Subtotal—State investment costs	$52,400

Model 1B Investment Costs

TSDF INVESTMENT COSTS

Under Model 1B, TSDFs again will have to make investments in 8 areas:

- Web-hosting software
- Manifest form development
- EDI translation software
- Servers for Web applications
- Translation mapping from form format to TS 856 for state EPA
- Firewall software
- Intrusion-detection software
- 5,000-seat hardware PKI.

Table B-5 shows small TSDF investment costs under Model 1B.

Table B-5. Small TSDF Investment Cost under Model 1B

Cost element	Estimated cost
Web-hosting software	$1,300
Manifest form development	$14,400
EDI translation software	$5,000
SQL Database Software	$290
Application Development	$50,000
Servers for web application and SQL Database	$6,500
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
5,000-seat hardware PKI	$928,000
Subtotal—small TSDF investment costs	$1,020,480

Table B-6 shows medium TSDF investment costs under Model 1B.

Table B-6. Medium TSDF Investment Cost under Model 1B.

Cost element	Estimated cost
Web-hosting software	$1,300
Manifest form development	$14,400
EDI translation software	$5,000
SQL Database Software	$290
Application Development	$100,000
Servers for web application and SQL Database	$6,500
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
5,000-seat hardware PKI	$8,840,000
Subtotal—medium TSDF investment costs	$8,982,480

Table B-7 shows large TSDF investment costs under Model 1B.

Table B-7.

Cost element	Estimated cost
Web-hosting software	$695
Manifest form development	$14,400
EDI translation software	$38,500
Application Development	$600,000
Servers for web application and SQL Database	$10,000
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
5,000-seat hardware PKI	$8,840,000
Subtotal—large TSDF investment costs	$9,518,585

STATE INVESTMENT COSTS

Under Model 1B, states will have to make investments in two areas:

- EDI translation software to convert from 856 to state database format
- SQL database software to capture manifest data
- Loader software for flat file
- Servers to host the EDI translator.

Table B-8 shows state investment costs under Model 1B.

Table B-8. State Investment Cost under Model 1B

Cost element	Estimated cost
EDI translation software to convert from 856 to state database format	$38,500
SQL database software to capture manifest data	$3,000
Loader Software for flat file	$900
Servers to host EDI translator	$10,000
Subtotal—State investment costs	$52,400

Model 1C Investment Costs

TSDF INVESTMENT COSTS

Under Model 1C, TSDFs will again have to make investments in 8 areas:

- Web-hosting software
- Manifest form development
- EDI translation software
- Servers for Web applications
- Translation mapping from form format to TS 856 for state EPA
- Firewall software
- Intrusion-detection software
- 500-seat PENOP digitizing software.

Table B-9 shows small TSDF investment costs under Model 1C.

Table B-9.Small TSDF Investment Cost under Model 1C

Cost element	Estimated cost
Web-hosting software	$1,300
Manifest form development	$14,400
EDI translation software	$5,000
SQL database table to capture form data	$290
Application Development	$50,000
Servers for Web application	$6,500
Translation mapping from form format to TS 856 for State EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
500-seat PENOP digitizing software	$137,500
Subtotal—small TSDF investment costs	$229,980

Table B-10 shows medium TSDF investment costs under Model 1C.

Table B-10. Medium TSDF Investment Cost under Model 1C

Cost element	Estimated cost
Web-hosting software	$1,300
Manifest form development	$14,400
EDI translation software	$5,000
SQL Database Software	$290
Application Development	$100,000
Servers for web application and SQL Database	$6,500
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
5,000-seat PENOP digitizing software	$375,000
Subtotal—Medium TSDF investment costs	$517,480

Table B-11 shows large TSDF investment costs under Model 1C.

Table B-11. Large TSDF Investment Cost under Model 1C

Cost element	Estimated cost
Web-hosting software	$695
Manifest form development	$14,400
EDI translation software	$38,500
Application Development	$600,000
Servers for web application and SQL Database	$10,000
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
5,000-seat PENOP digitizing software	$375,000
Subtotal—large TSDF investment costs	$1,053,585

STATE INVESTMENT COSTS

Under Model 1C, states will have to make investments in the same four areas:

- EDI translation software to convert from 856 to state database format
- SQL database software to capture manifest data
- Loader software for flat file
- Servers to host the EDI translator

Table B-12 shows state investment costs under Model 1C.

Table B-12. State Investment Cost under Model 1C

Cost element	Estimated cost
EDI translation software to convert from 856 to state database format	$38,500
SQL database software to capture manifest data	$3,000
Loader Software for flat file	$900
Server to host EDI translator	$10,000
Subtotal—State investment costs	$52,400

Model 1D Investment Costs

TSDF INVESTMENT COSTS

Under Model 1D, TSDFs again will have to make investments in 8 areas:

- Web-hosting software
- Manifest form development
- EDI translation software
- Server for Web applications
- Translation mapping from form format to TS 856 for state EPA
- Firewall software
- Intrusion-detection software

Table B-13 shows small TSDF investment costs under Model 1D.

Table B-13. Small TSDF Investment Cost under Model 1D

Cost element	Estimated cost
Web-hosting software	$1,300
Manifest form development	$14,400
EDI translation software	$5,000
Server for Web application	$290
SQL Database Software	$50,000
Application Development	$6,500
Translation mapping from form format to TS 856 for state EPA	$3,000
Firewall software	$2,995
Intrusion-detection software	$8,995
Subtotal—small TSDF investment costs	$92,480

Table B-14 shows medium TSDF investment costs under Model 1D.

Table B-14. Medium TSDF Investment Cost under Model 1D

Cost element	Estimated cost
Web-hosting Software	$1,300
HWM Form Development	$14,400
EDI Translation Software	$5,000
SQL Database Software	$290
Application Development	$100,000
Servers for web application and SQL Database	$6,500
Translation mapping from form format to TS 856 for State EPA	$3,000
Firewall Software	$2,995
Intrusion Detection Software	$8,995
Subtotal—medium TSDF investment costs	$142,480

Table B-15 shows large TSDF investment costs under Model 1D.

Table B-15. Large TSDF Investment Cost under Model 1D

Cost element	Estimated cost
Web-hosting Software	$695
HWM Form Development	$14,400
EDI Translation Software	$38,500
Application Development	$600,000
Servers for web application and SQL Database	$10,000
Translation mapping from form format to TS 856 for State EPA	$3,000
Firewall Software	$2,995
Intrusion Detection Software	$8,995
Subtotal—large TSDF investment costs	$678,585

STATE INVESTMENT COSTS

Under Model 1D, states will have to make investments in the same four areas:

- EDI translation software to convert from 856 to state database format
- SQL database software to capture manifest data
- Loader software for flat file
- Servers to host the EDI translator.

Table B-16 shows state investment costs under Model 1D.

Table B-16. State Investment Cost under Model 1D

Cost element	Estimated cost
EDI translation software to convert from 856 to state database format	$38,500
SQL database software to capture manifest data	$3,000
Loader Software for flat file	$900
Server to host EDI translator	$10,000
Subtotal—State investment costs	$52,400

Model 2 Investment Costs

Nearly all the investment costs are the same under Model 2 as under Model 1, with the exception of state investment costs and EPA investment costs.

STATE INVESTMENT COSTS

Under Model 2, states investments will decrease because CRF is providing much of the investment. The states will still need to accept in an interface from the flat file (provided by the CRF) to the database, but over costs should decrease as shown in Table B-17.

Table B-17 shows state investment costs under Model 2.

Table B-17. State Investment Cost under Model 2

Cost element	Estimated cost
EDI Translation Software to convert from 856 to state database format	$30,800
SQL Database Software to capture HWM data	$2,400
Loader Software for flat file	$900
Servers to host EDI translator and Oracle database	$8,000
Subtotal State Investment Costs	$42,100

CRF INVESTMENT COSTS

Under Model 2, the CRF will have to provide investments in one area:

- EDI translation software to convert from 856 to state database format

Table B-18 shows CRF investment costs under Model 2.

Table B-18. CRF Investment Cost under Model 2B

Cost element	Estimated cost
CRF System Development	$1,000,000
EDI translation mapping to convert from 856 to state database format	$3,000
Subtotal CRF Investment Costs	$1,003,000

Investment Expense Summary

Table B-21 summarizes the expected investment expenses for each individual stakeholder under each of the eight submodels.

Table B-19. Investment Expense Summary

Model	Investment source	Cost
Model 1A	LQGs	$5,000
	Small TSDF	$172,480
	Medium TSDF	$577,780
	Large TSDF	$1,113,885
	States	$52,400
Model 1B	LQGs	$5,000
	Small TSDF	$1,020,480
	Medium TSDF	$8,982,480
	Large TSDF	$9,518,585
	States	$52,400
Model 1C	LQGs	$5,000
	Small TSDF	$229,980
	Medium TSDF	$517,480
	Large TSDF	$1,053,585
	States	$52,400
Model 1D	LQGs	$5,000
	Small TSDF	$92,480
	Medium TSDF	$142,480
	Large TSDF	$678,585
	States	$52,400

Table B-19. Investment Expense Summary

Model	Investment source	Cost
Model 2A	LQGs	$5,000
	Small TSDF	$172,480
	Medium TSDF	$577,780
	Large TSDF	$1,113,885
	States	$42,100
	CRF	$1,003,000
Model 2B	LQGs	$5,000
	Small TSDF	$1,020,480
	Medium TSDF	$8,982,480
	Large TSDF	$9,518,585
	States	$42,100
	CRF	$1,003,000
Model 2C	LQGs	$5,000
	Small TSDF	$229,980
	Medium TSDF	$517,480
	Large TSDF	$1,053,585
	States	$42,100
	CRF	$1,003,000
Model 2D	LQGs	$5,000
	Small TSDF	$92,480
	Medium TSDF	$142,480
	Large TSDF	$678,585
	States	$42,100
	CRF	$1,003,000

Appendix C
"To-Be" Annual Operating Cost Detail

BACKGROUND

This appendix details the annual cost to operate the "to-be" system for each of the eight model scenarios. Investing in either the Model 1 or Model 2 solution will decrease operating costs in nearly all areas of manifest processing. The impact of the investments on operating costs is described below.

MANIFEST PREPARATION

Two factors drive the savings in manifest preparation: the reduction in the burden of preparing manifests for those stakeholders that implement electronic commerce, and the implementation rate of those types of stakeholders.

Appendix D
Abbreviations

ANSI	American National Standards Institute
ASC	Accredited Standards Committee (ANSI)
B2B	business-to-business
CA	certification authority
CFR	Code of Federal Regulations
CRF	central receiving facility
DOM	Document Object Model
DOT	Department of Transportation
EDI	electronic data interchange
EPA	U.S. Environmental Protection Agency
ER	electronic reporting
HWM	Hazardous Waste Manifest
HWR	Hazardous Waste Report
ICR	Information Collection Request
LQG	large-quantity generator
OSW	Office of Solid Waste (EPA)
PKI	public key infrastructure
RCRA	Resource Conservation and Recovery Act
SQG	small-quantity generator
TSDF	hazardous waste treatment, storage, and disposal facility
XML	Extensible Markup Language
XSL	Extensible Style-Sheet Language